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THE FIRE-PROOF EXCURSION STEAMER JAMESTOWN.

BY ALEXANDER WILLS.

When, on June 15, 1904, the excursion steamer *General Slocum* burned to the water's edge in the East River, while carrying a Sunday school excursion, and one of the most awful calamities of our maritime history occurred in the frightful loss of life which followed, the attention of the whole country was forcibly drawn to two points, namely:

(*a*) The criminal negligence of the owners in failing to provide proper fire and life-saving equipment, and of the United States Steamboat Inspectors in failing to properly inspect the vessel and see that the requirements of the inspection service were complied with.

Shipbuilding and Dry Dock Company, for the Norfolk & Washington Steamboat Company, and now running in the excursion business on the Potomac, but intended primarily for day service between Washington and Norfolk in connection with the Jamestown Tercentennial Exposition, to be held in Hampton Roads in 1907.

The idea of a fire-proof steamer for this service originated with Captain John Callahan, the general manager of the Norfolk & Washington Steamboat Co., and after competitive bids, the contract for the vessel was given to the Newport News Company, by whom the general design and details were developed.

THE NEW FIREPROOF EXCURSION STEAMER JAMESTOWN, FOR POTOMAC RIVER AND CHESAPEAKE BAY SERVICE.

(*b*) The rapidity with which the ordinary type of excursion steamer can be consumed by fire, should one break out.

The persons criminally responsible for the former state of affairs were summarily dealt with, and those familiar with the instructions issued by the Steamboat Inspection Service to the Supervising and Local Inspectors regarding the rigid inspection of vessels, and with the changes in the United States Steamboat Inspection Rules relative to their equipment, can readily appreciate that a repetition of the *Slocum* disaster would be well nigh impossible, so far as loss of life is concerned.

The question of protection against fire by the use of non-inflammable materials in the construction of passenger steamers generally, and especially those of the excursion type, however, has not had the same attention paid to it. The vast majority of steamers already built, and of those building, are of the same general type as the *Slocum*, in so far as the upper structure of the vessel is concerned, and offer as little resistance to fire.

A notable exception, however, to this type is the day passenger steamer *Jamestown*, recently built by the Newport News

The *Jamestown* is a side-wheel steamer of the familiar river type, but differs from them all in the fact that she is practically fire-proof, the first vessel to be so constructed in this country, The hull, lower and main decks, saloon and shade deck beams, all deck houses and inclosures with all divisional bulkheads, are of steel, and with the exception of the furniture, doors, windows and such fittings in the galley and pantry as could not readily be made of metal, there is no exposed wood-work. She is of the following principal dimensions:

Length over all	262 feet
Length between perpendiculars	250 feet
Beam over guards	63 feet
Beam molded	38 feet
Depth molded	14 feet 6 inches

The general arrangement of the vessel is indicated on the plans and photographs accompanying this description. From them it will be seen that the vessel has complete main, saloon and shade decks, and a lower deck forward and aft of the machinery space. Everything has been designed to contribute as much as possible

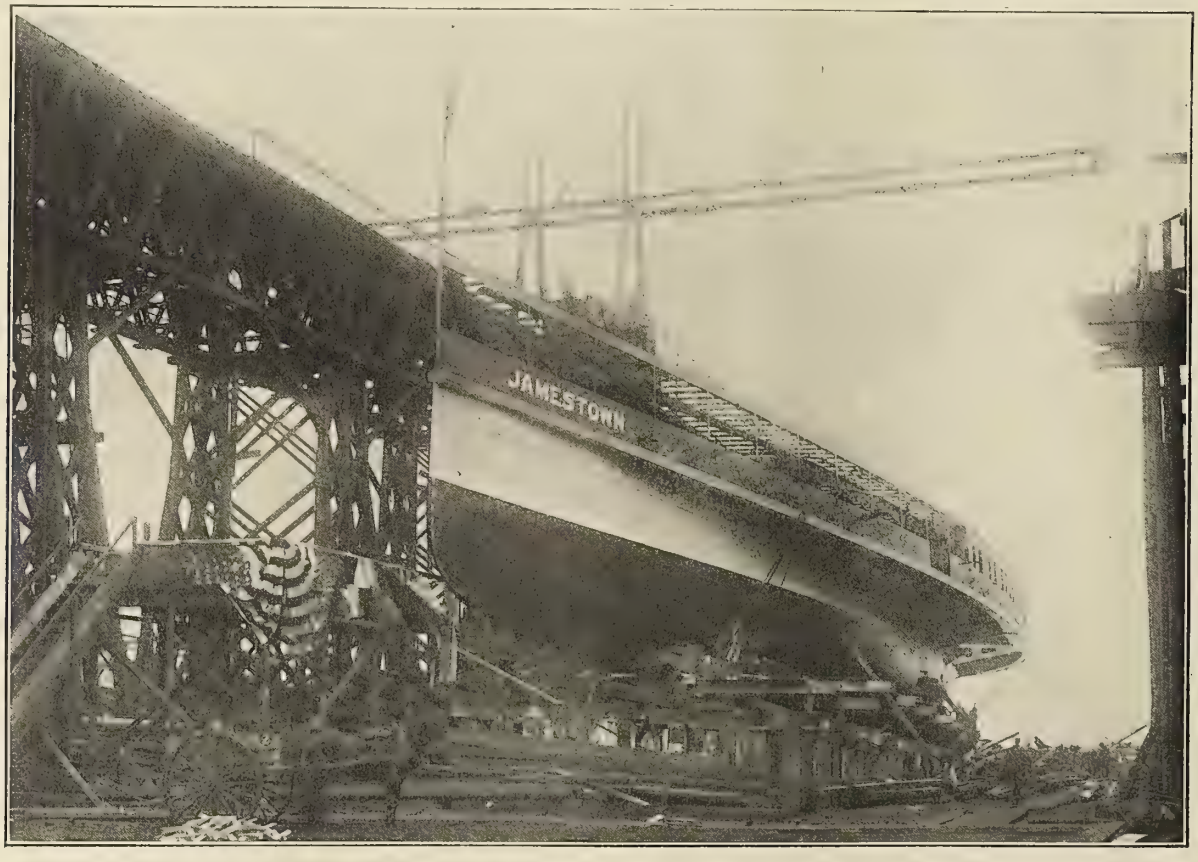
to the comfort and safety of the passengers, the vessel being intended exclusively for passenger service, the main, saloon and shade decks being devoted entirely to the passengers.

Starting with the lower deck forward the arrangement of quarters, etc., is as follows:

The fore peak up to the main deck is used to carry fresh water for boiler feed. Immediately aft of it on the lower deck is a steel chain locker extending across the vessel. Aft of this locker are quarters for the firemen and crew, with berths for eight firemen and coal passers on the port side, and for six seamen on the starboard side, with a steel divisional bulkhead between. Two staterooms for oilers and watchmen are fitted on the port side aft of the crew's quarters, and separate washroom and toilets on the starboard side, with a passage between, from which a companion leads to the main deck, with a booby hatch above. Metal berths are fitted in all these quarters, and a metal locker for each man. The deck covering in the quarters and passage is linoleum, and cement tile is laid in the washroom and toilets. Between the above quarters and the forward boiler room bulkhead a bar-room is located, which extends across the vessel. The counter in this room is built of steel, with a marble top. A wine and liquor storage room is built in the forward port corner, and a toilet with access from the bar-room is fitted on the starboard side forward. The deck is covered with interlocking rubber tiling and in the toilet room with mosaic tile. Access to the bar-room is obtained by means of an inclosed stairway from the forward end of the main deck inclosure.

The machinery space occupies the body of the vessel amidships. In the boiler room, which is forward of the engines, the four boilers are placed two abreast with a common athwartship fireroom. Side bunkers of about 75 tons capacity are fitted the length of the boiler room, these bunkers being coaled through scuttles in the passages on the main deck. The engine room is immediately aft of the boiler room, and, below the main deck, extends the full width of the vessel. The galley is located aft of the engine room, and is very large and roomy, having a capacity for cooking for 250 people. The equipment consists in a 16-foot Duparquet range, two 36-inch broilers, refrigerator, two large sinks, dressers, etc. The galley stove-pipe is led up through a light and air shaft at the after end of the engine casing. Access to the galley other than through the pantry is by means of a stairway alongside of the purser's office on the main deck. The galley floor is covered with brick, set in cement. Aft of the galley and extending across the vessel is the pantry, with a wide stairway leading from it to the dining room on the main deck. Two steam tables, a set of coffee urns, and the usual dressers and dish racks are fitted. A storeroom for dry stores is built on the port side at the after end.

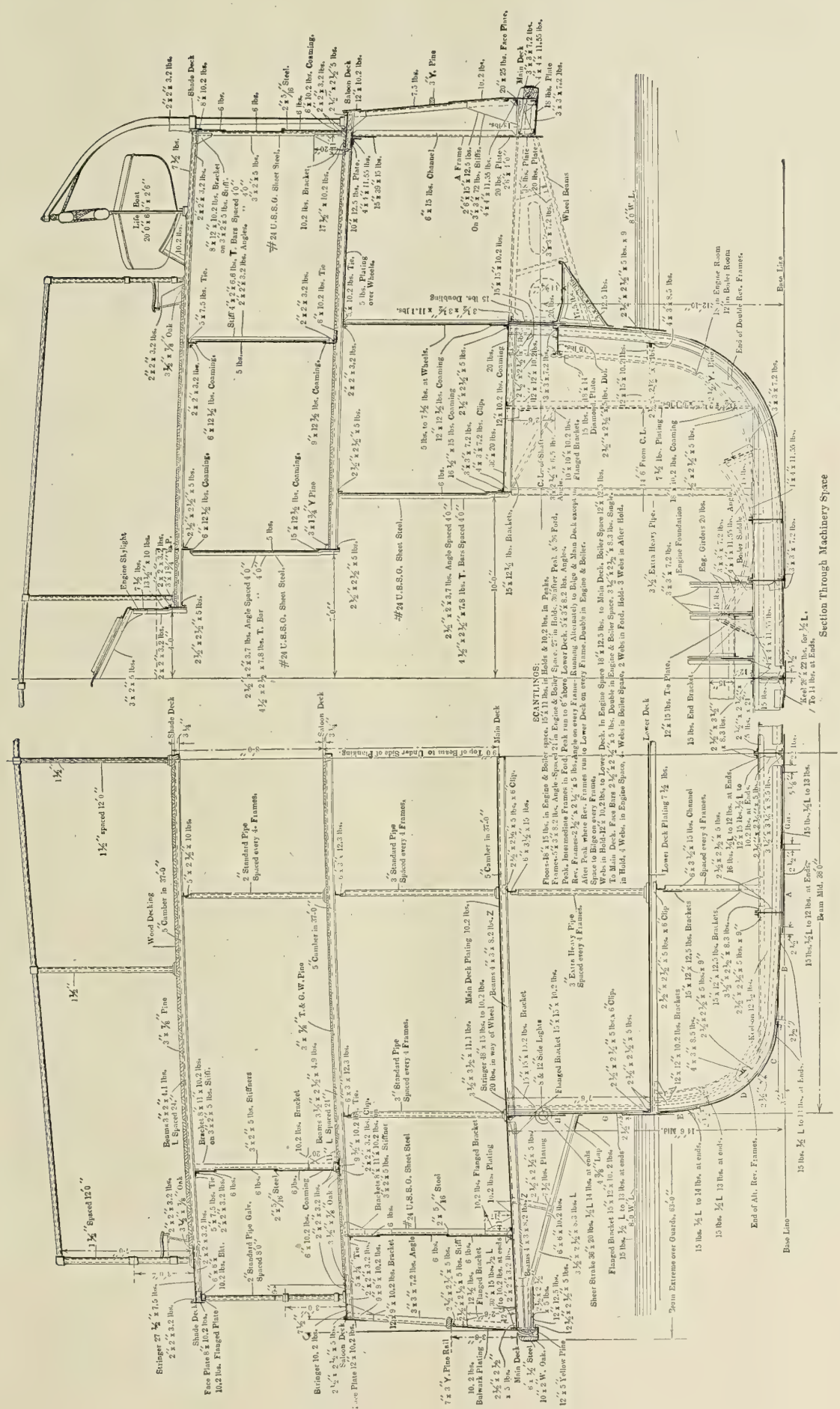
Beyond the pantry a central passage leads to quarters for the stewards' department. A large cold storage room is fitted on the port side just aft of the pantry, from which access to it is obtained. The officers' mess-room and a state-room for the stewardesses are aft of the cold-storage room. On the starboard side, quarters for the stewards' department are provided in four staterooms. The after end of the lower deck is devoted to the waiters, for whom eighteen berths are provided. Metal berths and lockers are provided for all these quarters, and the deck is covered with linoleum.



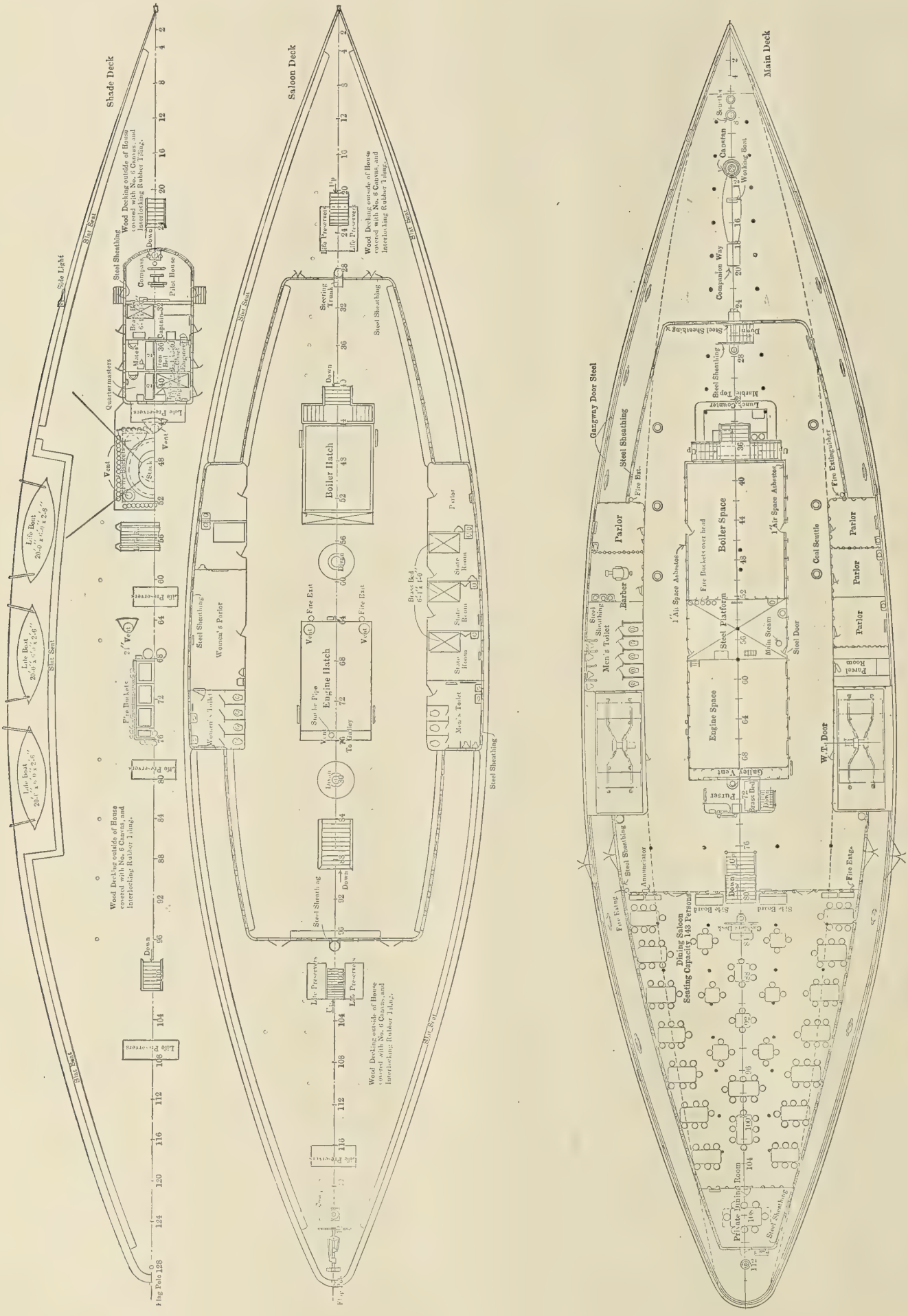
THE JAMESTOWN ON THE WAYS, JUST PREVIOUS TO BEING LAUNCHED AT NEWPORT NEWS.

On the main deck the machinery casings are 20 feet wide, and occupy the central part of the vessel. Aft of the engine casing is the purser's office and stateroom, and within the same inclosure is the stairway to the galley. The purser's office faces a large lobby, on the opposite side of which the main stairway to the upper saloon is located.

The dining room is located aft on the main deck, with a small private dining room at its after end. It is provided with a large number of small dining tables, with a total seating capacity for 143 persons, besides 10 in the private room. The dining room is entered from the lobby through double doors on each side of the main stairway.



MIDSHIP SECTION OF THE JAMESTOWN, AND SECTION THROUGH MACHINERY SPACE, SHOWING SCANTLINGS IN DETAIL.



ACCOMMODATION PLANS COVERING SHADE, SALOON AND MAIN DECKS OF FIREPROOF EXCURSION STEAMER JAMESTOWN.

In way of the machinery casings on the main deck the sides of the vessel are carried up to the saloon deck, to form inclosures for the paddlewheels, and for parlors, etc. In this space three parlors and a parcel check room are fitted forward of the wheel box on the starboard side, and a parlor, barber's shop and men's toilet on the port side. At the forward end of the boiler casing a stairway leads to the upper saloon, and forward of this stairway is a lunch counter and refreshment stand with marble top. This stairway and lunch counter are protected from the weather by an inclosure, at the forward end of which is the stairway leading to the bar. Wide passages between the machinery casings and the parlors, etc., at the sides of the vessel, lead from the forward inclosure to the main lobby. The forward portion of the main deck is not inclosed, but is protected with high steel bulwarks.

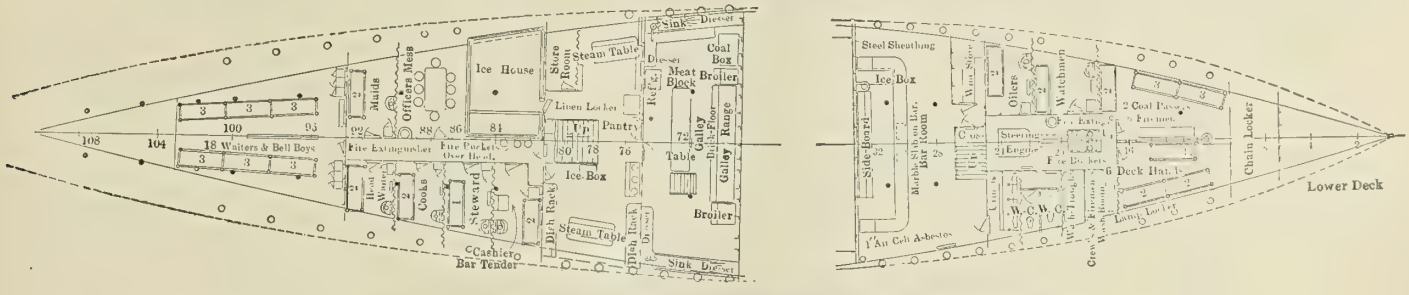
Floor covering on the main deck consists of interlocking rubber tiling on the exposed portion of the main deck forward, in the purser's office, lobby, dining room, and toilet. Heavy linoleum is fitted in the passages and elsewhere. The underside of the main deck over the engine and boiler rooms and the galley is insulated with asbestos air cell insulation.

On the saloon deck a large saloon is fitted with stairways forward and aft leading to the main deck. In it are fitted a parlor, three staterooms and a men's toilet on the starboard side, and a parlor, stateroom, women's parlor and toilet on the port side. Around the sides of the saloon leather upholstered seats are fitted, and willow rockers and chairs are scattered throughout.

Coming now to the structure of the hull, it will be seen by reference to the midship section that the form is quite full amidships, the rise of floor being small, but the bilges well rounded. The scantlings throughout were made as light as could well be, consistent with strength and stiffness, but the use of so much metal in the construction involved more weight than if wood had been used, and as the draft was limited to about 8 feet 6 inches, the section had to be made full in order to obtain fairly fine ends. The forefoot is cut away for some distance aft, but the stern is carried down in the usual manner.

The midship section illustrated herewith indicates the principal scantlings, and the general type of the construction of the hull. An inspection of it indicates that the vessel is built with a flat plate keel, a continuous center vertical keelson with continuous angles top and bottom, and floor stringers on top of the floors each side of the vertical keelson. The main framing is of the ordinary angle and reverse frame type, with floors on every frame, the spacing varying from 24 inches in the machinery space to 30 inches at the after end and 36 inches in the fore peak, where intermediate frames are fitted extending above the water line. Four web frames of plate and angle construction are fitted in the engine room and four in the boiler space, all extending to the main deck. There are also two web frames in the fore hold and three in the after hold, extending to the lower deck.

The longitudinal girders, in addition to the vertical keelson consist of a side intercostal plate keelson with double continuous angles on top of floors, and upper bilge stringer consisting of



ACCOMMODATION PLANS SHOWING AFTER END AND FORWARD END OF LOWER DECK.

Brass beds are fitted in the staterooms, the other stateroom furniture consisting of willow chairs, an oak table, mirror and toilet rack. Each private parlor is furnished with four willow chairs, a willow couch upholstered in leather, mirror, toilet rack and an oak table. Ample deck space for passengers is provided at the forward and after ends of the saloon deck, which exposed deck is covered with interlocking rubber tiling. Open stairways forward and aft leading to the shade deck.

The shade deck extends the full length of the vessel, and is covered throughout with awnings carried on pipe stanchions and ridge bars.

A raised pilot house is located forward on this deck, and accommodations in five staterooms are provided for the captain, deck officers and engineers in a deck house aft of the pilot house. The interior of the pilot house and the above deck house is lined with sheet steel, similar to that in the passenger spaces. The rails around the shade deck, as well as the saloon deck, are pipe with wire mesh panels. Slatted seats are fitted all around these decks in way of the rails. One thousand deck chairs with backs are provided for the open deck spaces.

The interior of all the passenger quarters is cork painted. The predominating color is pale green, with white trimmings in the main saloons and passages; the parlors and staterooms are each finished in an individual color. The windows in all the passengers' and officers' quarters have silk-faced pantasote sliding curtains with nickel plated fittings. Lavatories with running water are fitted in all parlors and staterooms. A complete steam heating system is installed, with radiators in all the different cabins and rooms.

double continuous angles. In the machinery spaces, where the lower deck is omitted, the stringer angle is carried through and doubled. Additional longitudinal girders are fitted in the engine spaces, to take the engine foundations, and a side stringer is fitted in the way of the wheel sponsons.

The shell plating is fitted in raised and sunken strakes, with lapped butts below the water line and butt-straps above.

Water-tight transverse bulkheads are fitted at the fore peak, the forward end of the boiler room, after end of the engine room and at the after peak. The three former extend to the main deck and the latter to the lower deck. A non-watertight bulkhead is fitted between the boiler and engine rooms, extending to the main deck. Longitudinal bulkheads are fitted the full length of the boiler room, to form side coal bunkers.

The lower deck is a flush-plated steel deck, with angle beams on every frame, and is fitted between the collision bulkhead and the forward boiler room bulkhead, and between the engine room bulkhead and the stern.

The main deck and guard beams are of Z-bar section, fitted to every frame. They are cut at the sides of the hull, and bracketed to the frames and shell by plate brackets. The main deck is flush plated throughout with No. 10 plate. Angle bar braces with flanged plate brackets connecting to the shell and to the guard face plate and under guard to stringer are fitted on alternate guard beams, excepting where the guards narrow in at the ends of the vessel, at which point plate brackets are fitted in lieu of beams. Special beams of plate and angle construction are fitted at the ends of the wheel inclosure, in way of which a heavy box girder is fitted to support the wheel eccentric bearing.

The saloon and shade deck beams are inverted angles with wood fillers. Steel stringer plates are fitted on each of these decks, and the shade deck is also plated over under the life boats. The other portions of the saloon and shade decks are decked with tongued and grooved white pine. Outside of inclosures this wood decking is covered with canvas, on which is laid interlocking rubber tiling. Within the inclosures the deck is covered with heavy linoleum, such as is used on United States naval vessels. The under side of these decks is covered with stamped galvanized sheet steel, of a simple fluted pattern, with cornices to match at the beams.

On the main deck the machinery casings extend practically the full length of the machinery space, with a divisional bulkhead between; at the forward end of the engine room the main deck plating is carried across the vessel to form the operating platform. Above the saloon deck separate casings are carried up above the shade deck level, and the engine room casing has a large metal frame skylight above, with hinged shutters operated from the platform. Windows are fitted in the engine casing on both the main and saloon decks, to give light to the passages and afford a view of the machinery. The whole of the boiler casing is insulated with asbestos air cell, held in place by sheet steel ceiling.

All deck houses, including the pilot house, and all inclosure bulkheads throughout the vessel, are of steel. The machinery casings, the passage way bulkheads on the main deck, and the inside bulkheads of the staterooms, etc., on the saloon deck, are panelled, thus adding materially to the general appearance. The divisional bulkheads between the staterooms are in general built of corrugated steel plate similar in construction to those used in naval vessels.

All stairways throughout the vessel are built of plates and angles with metal rails, the treads being covered with rubber. The interior of all cabins, staterooms, etc., in way of stiffeners, is finished with light steel ceiling, the only wood work being the window sash and doors.

For use in preventing excessive listing when the passengers are all on one side of the vessel, trimming tanks are fitted under the guards on each side forward of the wheels. These tanks are formed by plating under the guard braces, and are arranged to be filled by branch pipes from the circulating pump discharge. Drain valves are fitted in the bottom of each tank, and are provided with operating gear leading to a lever on the engine platform, the whole trimming arrangement being under the engineer's control.

The life saving equipment of the *Jamestown* consists of six 20-foot metallic life boats stowed in metal chocks on the shade deck, and swung from swinging davits, and one life raft. There are also stowed under the passenger decks and in accessible places in the saloon and elsewhere 2,550 cork life preservers.

Notwithstanding the extensive use of metal in the construction of the *Jamestown*, and the whole general fire-proof feature the fire-fighting equipment is as complete as on any excursion steamer, the United States inspection officials making no exception to their full requirement. A fire main runs to all parts of the vessel, with hose plugs located in convenient positions. Portable chemical fire extinguishers are also distributed throughout, and hand fire pumps located forward and aft.

The steering gear consists of a Williamson 6 by 6-inch double cylinder steam steering engine, located in the lower deck passage forward, connected to the steam steering wheel in the pilot house by shafting and bevel gears, and to a quadrant on the rudder stock by chain and metal rod leads under the main deck. A hand steering wheel with separate rope leads is also located in the pilot house, thus providing an emergency gear in case the steering engine is out of commission. In addition to the steam and hand gear, a hand steering gear of the Napier type is located on the saloon deck aft, and connected directly to the rudder stock.

Owing to the fact that the vessel will have a long run through Chesapeake Bay, with a liability of encountering some of the storms which occasionally trouble those waters, the anchor and cable equipment is somewhat heavier than customary on excursion steamers. There are two anchors of 1,400 and 1,200 pounds, and 90 fathoms of 1⅛-inch stud link chain, the latter stowed in a locker on the lower deck. A vertical steam windlass of the American Ship Windlass Company's make, with a capstan barrel, operated by a pair of 5 by 7-inch engines, is located on the main deck, for handling the chain.

The *Jamestown* is lighted throughout by electricity, a Sturtevant generator of 25 kilowatt capacity being located in the lower engine room. There are about 300 twenty candle power lights installed. A 14-inch Rushmore search light is fitted on top of the pilot house.

The usual means of communication is provided between the pilot house and engine room. A system of call bells from the parlors, staterooms, etc., is also provided, with an annunciator in the main lobby.

Fresh water for feed make-up is carried in the forward and after peaks, and for domestic and culinary use in two circular tanks in the lower hold aft. A fresh water pump in the engine-room draws from these tanks, and discharges into a distributing tank on the shade deck, from which is taken the supply to the lavatories. A similar distributing tank for salt water is also located on the shade deck, and connected to the sanitary pump in the engine room. This tank provides all water for flushing the toilets and urinals by gravity. In arrangement, number and general design of toilet rooms, the *Jamestown* is unsurpassed by any vessel of similar type in this country.

PROPELLING MACHINERY.

In the design of the propelling machinery another departure was made from the standard type of paddle steamer. While the majority of American side-wheel steamers have engines of the walking beam type, of late years this type of engine has been to a considerable extent displaced by inclined compound and triple-expansion engines. The latter have, as a rule, a fairly long stroke, and the diameter of the paddle-wheels does not differ materially from those in use with beam engines. In the *Jamestown* the engine is of the inclined type, but both the stroke and the diameter of wheel were made lower than in the prevailing type of inclined engines, following in this respect the English practice in channel steamers.

Another somewhat uncommon feature is the location of the wheels aft of the cylinders, the prevailing custom when the boilers are located forward of the engines being to have the wheels at the forward end of the engine room. In the model experiment it was found that locating the wheels forward would put them in a wave hollow, and with the small diameter of wheel to be used, the center of shaft would be rather low and the dip of the buckets would be excessive. These objections were overcome by reversing the positions of the cylinders and wheels, the waterline at the after position being about the normal line.*

The contract for the *Jamestown* required that she be capable of maintaining a speed of 18 miles per hour, and that the mean draft should not exceed 8 feet 6 inches. To enable them to meet this speed requirement with the least amount of power, the contractors had a model of the vessel towed in the United States model tank at Washington, and from the results of this experiment the effective horsepower required to drive the vessel at the required speed was obtained. With this as a basis, the size of the main engines was determined upon. The engine is a two-cylinder inclined compound, with 30 and 64-inch diameter cylinders, and a stroke of 66 inches.

Each cylinder with its valve chest forms a separate casting, on which are also cast flanges for bolting the cylinders to the engine foundation, and for the crosshead guides. The high-pressure valve chest is arranged to take steam in the center and exhaust

*The *Hendrick Hudson* has an inclined direct-acting engine, similarly situated.

at the ends. No liner is fitted in the cylinder, but liners are fitted for the piston valve, which is 13 inches diameter, of the plug type, with separate follower and adjustable ring.

The low-pressure cylinder is fitted with a double-ported slide valve, the valve seat having a false face. A relief frame is fitted on the back of the slide valve, and consists of a wedge shaped cast iron ring, working in a similar shaped groove on a frame, bolted to the back of the valve, the ring fitting between this frame and the valve chest cover, and having pressure applied externally by sixteen 5/8-inch steel coil springs.

Both valves are worked by Stephenson link motion with double bar links. The valve stems are of steel, the head end being guided by cast iron bonnets with brass bushings, and the crank end by cast iron guides with adjustable brass bushings. The link ends are fitted with brass bushings and steel caps. The link blocks are cast steel with brass gibs. The eccentric rods are steel with forked ends to span the links. Eccentrics and eccentric straps are cast iron.

position side gibs. Connecting rods are 148 inches long between centers, 6 inches diameter at crosshead end, 6½ inches diameter at crank end and 7¼ inches diameter at center. The crosshead end is forked to span the crosshead, and is fitted with brass bearings; the crank pin boxes are cast steel, lined with white metal.

The shaft is forged steel of the built-up type, with wrought iron cranks. Crank pins are 12 by 12 inches, secured to the inboard cranks by taper and nut, and the usual drag end type in the outboard cranks. The main shaft is 13 inches diameter in the main bearings and 14 inches diameter in the outboard bearings and in wheel centers. The outboard bearings are fitted on sponsons built outside the hull, and are cast steel pillow blocks with composition bottom box and cast steel cap, the bearings being lined with white metal. The main bearings consist of pillow blocks of cast iron, with cast iron bottom boxes, and caps lined with white metal, the whole being secured to cast steel sole pieces and securely fastened to the engine foundation. Each pillow block

THE UPPER SALOON OF THE JAMESTOWN, LOOKING FORWARD. NOTE THE QUIET SIMPLICITY.

The reversing gear consists of a steam cylinder 12 inches diameter by 18½ inches stroke, bolted to the high-pressure cylinder, and connected to the links through cast steel rocker arms provided with heavy cast iron counter weights and double forged steel suspension rods. The reverse shaft is located below the links, and is supported by the pillow blocks secured to the engine foundation. The main throttle is 10-inch diameter, of the balanced type, fitted with a 3-inch by-pass valve. The operating levers for the throttle by-pass and reversing gear are located on a platform at the main deck level, where are also grouped the levers for the drain cocks. The receiver pipe between the cylinders is steel in the main body, with copper elbows.

The high-pressure piston is cast iron, of the plug type, with separate cast iron combined follower and ring. The low-pressure piston is cast steel, with a wrought iron follower and a cast iron packing ring. The latter is in three sections, with white metal strips on the face, and is set out with steel springs excepting on the bottom, where solid distance pieces are fitted. Piston rods are 6½-inches diameter, secured to the pistons and crossheads by taper ends and nuts. All piston rod and valve-stem stuffing boxes are fitted with United States metallic packing. Crossheads are wrought iron, with double pins 6 by 7 inches, and cast iron slippers lined with white metal on top and bottom, and with com-

has a horn cast on, through which a wrought iron tie is fitted to tie the main bearings together. The cylinders and main bearings are tied together by four forged steel struts, which also form the crosshead guides. These struts are rectangular in way of the crosshead guides, and circular elsewhere. At about their mid-length, they are supported by pillars from the engine foundation.

The latter is a substantial structure of plate and angle construction, with longitudinal girders the length of the engine room, and built up at the ends to suit the cylinders and main bearings.

The paddle wheels are of the feathering type, 18 feet 3 inches extreme diameter, and 17 feet diameter over the buckets. There are nine curved steel plate buckets, 3 feet deep and 9 feet wide. The wheel centers, eccentrics and bucket arms are cast steel and the wheel arms and eccentric rods are wrought iron forgings, with lignum vitae bushings. All bucket pins are forged steel, cased with phosphor bronze sleeves.

The main condenser is an independent cylindrical one, with cast iron shell and heads. The tube plates are brass, and there are 2,616 5/8-inch brass tubes, with a total cooling surface of 3,031 square feet.

The circulating pump is of the centrifugal type, driven by a vertical 8 by 10-inch engine. The body of the pump is cast iron, composition fitted and the pump runner is composition. All

engine room pumps are independent of the main engine. The air pump is a vertical cross-connected simplex featherweight, with double cylinders 8 by 16 by 12 inches. The other pumps consist of one main feed and one donkey pump, each 12 by 8 by 12 inches, of the vertical simplex type, and one sanitary, one bilge and one feed water pump, of the horizontal simplex type, each 5½ by 8 by 7 inches.

The four main boilers are located in one compartment, with a common stokehold, and their uptakes lead into one common stack. The boilers are of the Scotch type, 12 feet 9 inches diameter by 11 feet 6 inches long built for a working steam pressure of 150 pounds per square inch. Each boiler has three 39-inch inside diameter Morison corrugated furnaces, with a common combustion chamber, and 246 3-inch tubes. The shells of the boilers are built with one course only. The total grate surface is 244 square feet, and the total heating surface 7,600 square feet, the ratio being 31.15 to 1. Dry pipes are fitted in all boilers. The stack is 7 feet diameter, and is about 64 feet high above the grates.

For discharging ashes overhead, a water-tight trunk is fitted through the bottom of the vessel at the middle of the fireroom, and extends above the water-line. To this trunk is attached a long stroke steam ash hoist, with ropes and guides for hoisting the ash buckets to the top of the trunk, into which the bucket is emptied automatically.

After the completion of the *Jamestown,* and before delivery to the owners, she was given a speed trial to demonstrate her seaworthiness, etc., as well as her capability of making the contract speed. The course chosen was one between Thimble and Cape Henry lights at the mouth of Chesapeake Bay, a distance of a little over 13 miles. On the run out, with the tide, the average speed was 19.93 miles per hour, and returning, against the tide, the average was 17.65 miles, or a mean speed of 18.79, which materially exceeded the contract speed. During these trials the engines worked perfectly, the average revolutions with and against the tide being 53.13 per minute.

In the *Jamestown* the owners consider they have a steamer in which the comfort and safety of the passengers has been most carefully taken care of, and the verdict of opinion is that she is a big step in advance of ordinary excursion boat construction. Her popularity on her present run augurs well for next season, when she will run between Washington and Norfolk in connection with the Jamestown Exposition. The Norfolk and Washington Steamboat Company now provide a nightly service between the above cities, but there is no day steamer from either Baltimore or Washington to Norfolk, and it is expected that the *Jamestown* will be very popular with tourists to the Exposition, as it will afford them a delightful daylight trip down the Potomac and Chesapeake Bay.

Machinery of the Trafford Hall.

The engines of the *Trafford Hall** have cylinders 24¾, 42 and 73 inches in diameter, with a stroke of 48 inches. There are two main boilers 15 feet 2 inches in diameter by 12 feet long; and an auxiliary boiler 12 feet 6 inches in diameter by 11 feet 6 inches long. All three were made for a working pressure of 215 pounds and all are fitted with Howden's system of forced draft.

This boiler pressure, 215 pounds, is undoubtedly a very high pressure for triple expansion engines, but the desire of the superintending engineer of the owners was to test the relative efficiency of this pressure in three cylinders, coupled with the fact of superheated steam, as against quadruple engines having the same boiler pressure. The results of the first voyage of the *Trafford Hall* were reported as very satisfactory, but with the meagre information as yet before them, the builders are not in a position to recommend this high pressure in triple expansion engines. They are, however, at present building three more vessels for the same company, all of which will have this pressure, which shows that the owners are emphatically in favor of it.

*For description of ship, see page 188 of our May (1906) number.

The Italian Lloyd Steamship Florida.

BY DAGNINO ATTILIO.

The *Florida* is a new type of ship for the Italian merchant marine, similar to the class of steamers that the Hamburg-American Company has in service from Genoa to New York. But if the steamships of the *Belgravia* type, luxuriously furnished for third class passengers, deserve the name of "freight trains" for their slow speed (12½ knots on the trial and 11 knots in normal navigation), the *Florida,* which has two large engines, and is built, as the *Belgravia,* to carry emigrants and a large cargo, is superior to the latter, owing to her higher speed.

NEW STEAMSHIP FLORIDA, OF THE ITALIAN LLOYD LINE, BUILT IN GENOA.

The ship was built by the Societa Esercizio Bacini of Genoa, the hull being built at their yard at Riva Trigosa near Genoa, and the engines at the works on Genoa harbor. Four similar steamers have been built, the *Indiana* having reached New York, on her maiden voyage, February 22, 1906, with 1,500 passengers. The others are the *Louisiana* and *Virginia.*

The principal dimensions of hull and machinery are as follows:

Length between perpendiculars	370 feet 0 inches
Beam, extreme	48 feet 0 inches
Depth	38 feet 6 inches
Normal draft	28 feet 5 inches
Displacement at full load	9,000 tons

The two engines have cylinder diameters, 21¼, 33½ and 59½ inches; stroke of all pistons, 39⅜ inches. Cut-off at 0.80; 0.75; 0.62 of the stroke. Revolutions, 80. I. H. P. for the two engines, 3,000. Speed of the ship, 14.75 knots. Piston rods, diameter, 5⅜ inches. Diameter of crosshead pins, 6½ inches. Connecting rods, length center to center, 82 11/16 inches. Mean diameter of connecting rods 5 11/16 inches. Crank shafts, diameter 11 7/16 inches. Line shaft, diameter, 11⅝ inches. Thrust shaft, diameter, 11 7/16 inches. Stern tube shaft, diameter, 12¾ inches. Thrust collars, number on each shaft, 7; thrust surface, 4 square feet.

There are two main air pumps, one in each engine room, worked by the propelling engines, and of single acting type, with a diameter of 18¼ inches and a stroke of 19¾ inches; two main circulating pumps worked by propelling engines, of the double acting type, 11 1/16 inches in diameter, with a stroke of 19¾ inches; four main feed pumps of the simplex, vertical, double acting, center packed, plunger type.

The main condenser for each main engine is of cast iron with a cooling surface of 2,458.5 square feet. The tubes are ¾-inch in diameter, with a length between tube sheets of 16 feet 5 inches and a thickness (No. 18 B. W. G.) of 0.49 inch. The main steam pipe has a diameter at throttle of 5⅞ inches, with a thickness of ¼-inch.

The screw propellers are three-bladed, of Stone's bronze, and turn outboard when going ahead. They are designed as true screws, and the surfaces of the blades are ground smooth with an emery wheel, and edges filed sharp. The hubs and blades are cast separately, the latter being bolted to the hub by nine tap bolts each; and the bolt holes in the palms of the blades are elliptical, to permit of adjusting the pitch. When the pitch has been set, the space between the bolts and edges of the elliptical holes is filled in with fitted composition chocks to prevent the blades from turning and altering the pitch. The diameter of the propeller is 13 feet 10 11/16 inches; pitch, mean, 17 feet 4¾ inches; pitch ratio, 1.23; projected surface of three blades, 43 square feet.

There are five boilers of the Scotch single ended type, with a diameter of 13 feet 10 11/16 inches and a length of 10 feet 3 9/16 inches. The three furnaces for each boiler have each a mean diameter of 43 5/16 inches, with a grate surface of 60.7 square feet and a heating surface of 2,006 square feet. Ratio H. S. to G. S. 33. Working pressure, designed, 190 pounds per square inch.

The holds of the ship are capable of taking 3,600 cubic meters of cargo.

The third class accommodations provide for 1,500 passengers, in a style unsurpassed on any route. The 'tween deck spaces that remain exclusively for the emigrant's use are provided with 1,500 bunks of galvanized iron. It must be remarked that, while the governmental emigration law sets a height of 6 feet 7 inches beneath the beams, in 'tween decks, that height on the *Florida* is 7 feet 6 inches beneath the beam. The eight large quarters for the emigrants have the deadlights somewhat above the waterline when the ship is loaded, which allows for their always being opened, insuring ample natural ventilation.

COLD STORAGE ON BOARD SHIP.

PART V.

BY SYDNEY F. WALKER, M. I. E. E.

THE CONDENSER.

The condenser for refrigerating apparatus is designed to perform the same office for the refrigerant that the steam condenser does for the steam—to convert it to the liquid form. Its construction is very similar. There are two forms of condenser used in refrigerating work, the submerged, and the open. In both forms the hot gas passes through pipes, over which cooling water runs. In the submerged form, the pipes are usually in coils, in a circular tank, and the cooling water is kept continually in circulation over its surface. It is practically a surface condenser. In the open type, the pipes are usually made in grids, the cooling water being allowed to trickle down over them. The cooling effect is largely due, with the open type, to evaporation. In fact they are generally known as evaporative condensers, and are preferred on shore, wherever they can be employed, on account of their higher efficiency and the smaller quantity of cooling water required. A small portion of the water which trickles down over the pipes is evaporated, carrying off with it, approximately, 10,000 heat units for every gallon evaporated, where a gallon of water passing over the pipes in liquid form carries off only from 100 to 200 units.

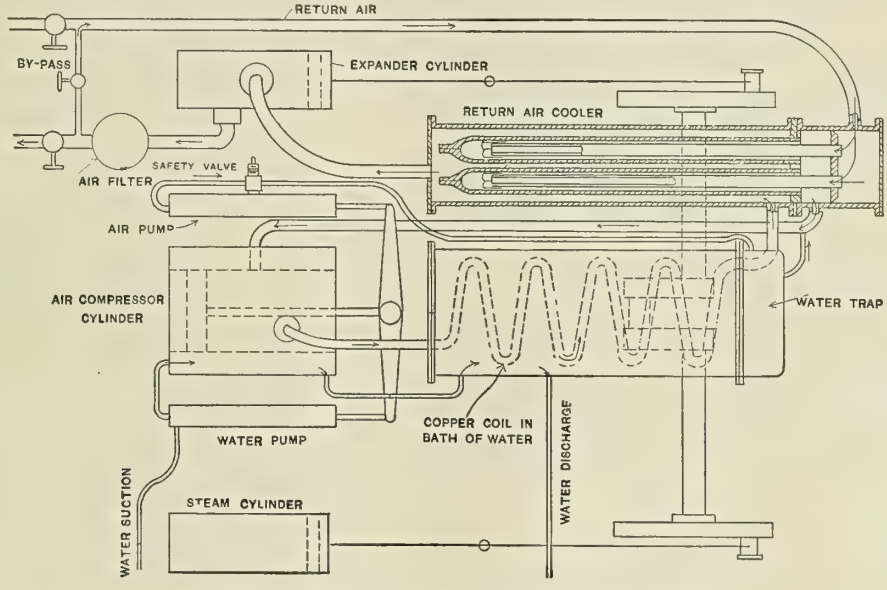


DIAGRAM OF ALLEN DENSE AIR REFRIGERATING MACHINE.

Condensers used for refrigerating apparatus are slightly different from those used for steam, mainly because it is so important that there shall be no leakage of the refrigerant. There are no joints in the pipes inside the submerged condenser. The coil is made in one long length, welded sometimes by electricity, sometimes by special lap welds, but never jointed. If joints are necessary, and where they are necessary, the pipe is brought out of the tank, and the joint made there. With open type condensers the pipes are all fitted into headers at each end. In either case, any kind of water may be used, provided that no crust is allowed to form on the outside of the pipe by the salts contained in the water. Sea water may be used, provided that this point is attended to. If a deposit is formed, a certain resistance is set up between the refrigerant inside and the cooling water outside, apart from and in addition to that of the pipe itself, with the result that the cooling water has not its proper effect, and more has to be used.

All refrigerating condensers are worked on the counter current principle, the cooling water and the hot gas circulating in opposite directions. The water usually passes from below upwards, while the hot gas enters above and passes downwards. The hottest gas meets the hottest water, and is partially cooled,

meeting colder and colder water as it passes downwards, and is itself becoming colder and colder, till at the bottom it meets the fresh and coldest water. The liquid refrigerant which is formed runs out at the bottom to a receiver, where one is used, and usually through an oil separator, to the evaporator coils.

Obviously the submerged condenser is the one adapted for ship work, but there are cases where the open condenser would do good work. It must be remembered that a current of air is of great service, especially when the air is warm and dry, as it very materially assists evaporation, and cooling with it. In the Savoy Hotel in London the cooling water for the refrigeration condenser is itself cooled by means of the equivalent of a cooling tower, fixed in the shaft which carries off the vitiated air from the chimneys, stoke hold, etc. Galvanized iron wire mats are hung in the shaft, and a fan at the bottom directs the air through them, while the water to be cooled trickles down over them. Something similar to this might be arranged on board ship for the refrigerating condenser, the coils in which the hot gas passes taking the place of the wire mats, and some of the hot air from the ship, if not too much saturated with moisture, being driven over it.

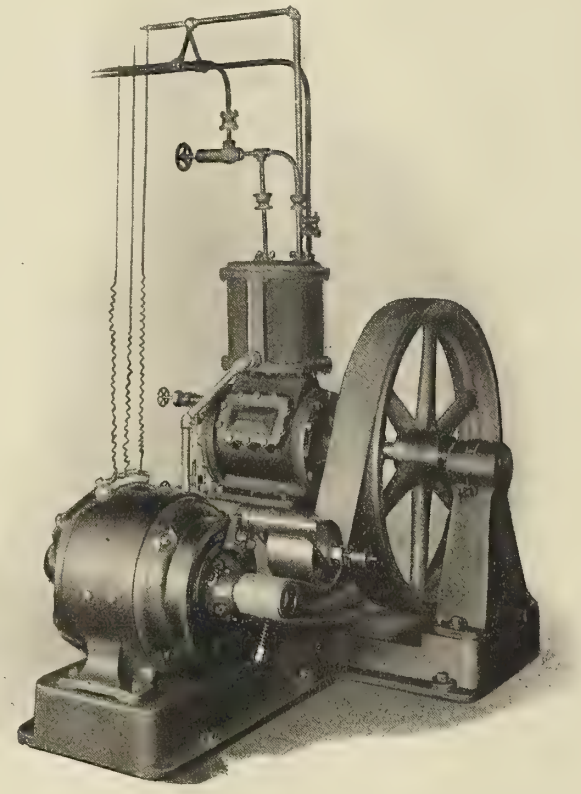
As already explained, there are three substances employed as refrigerants, ammonia, carbonic acid and sulphurous acid. All are worked upon the same lines, but the sizes of the apparatus and the pressures at which they are worked vary considerably. In addition there is another process employed with ammonia, known as the absorption process, which, after varying fortunes, appears to be coming to the front again, even for ship work. It is described below. The different agents have different latent heats, and therefore different refrigerating capacities. The capacity of any refrigerant depends upon its latent heat, that is, its ability to absorb heat in passing from the liquid to the gaseous state. This quantity is usually stated in British thermal units per pound of the refrigerant, just as that of steam is.

Perfectly anhydrous (water free) ammonia has a latent heat of 555.5 units per pound at zero F., the pressure being 30 pounds per square inch. Carbonic acid at the same temperature, but at a pressure of 310 pounds per square inch, has a latent heat of 123.2 units per pound; while sulphurous acid at the same temperature has a latent heat of 171.2 units. The latent heat varies with the temperature and pressure. The refrigerants employed have all their critical temperatures, above which they will not assume the liquid state, no matter to what pressure they are subjected. Apart from that, the temperature of the refrigerant varies with the pressure, just as in the case of steam. But as the temperature and pressure increase the latent heat decreases. Thus, at a temperature of —40 degrees F., and an absolute pressure of 10 pounds per square inch, the latent heat of ammonia is 579 units per pound, while at a pressure of 42 pounds per square inch, and a temperature of 15 degrees F., its latent heat is only 546 units per pound. Similarly carbonic acid, at a temperature of —22 degrees F., and a pressure of 195 pounds per square inch, has a latent heat of 136 units per pound, while at a pressure of 380 pounds per square inch, and a temperature of 14 degrees F., its latent heat is only 115 units per pound.

It will be observed that the latent heats are expressed in terms of pounds of the different substances, because all of these figures arising out of heat units are naturally referred to weight, since the heat unit goes by weight. But in refrigerating apparatus it is volumes that are dealt with. A certain volume of the gas which has done its work in the expansion coils is dealt with in the compressor at each stroke. Hence it is more important to know the latent heats of the different refrigerants per cubic foot, and then it will be seen that the apparent advantage of ammonia in the matter of latent heat is not maintained. One pound of ammonia measures 10.33 cubic feet at —4 degrees F., while one pound of carbonic acid, at the same temperature, measures only 0.312 cubic foot, and sulphurous acid 8.06 cubic feet. Hence the latent heat of a cubic foot of ammonia at —4 degrees is 56 units, while that of a cubic foot of carbonic acid is about 400 units at the same temperature, so that carbonic acid has the advantage.

In practice there are other matters to take into consideration, which bring the efficiencies of the three agents to about the same value. Carbonic acid is supposed to be not so efficient in hot climates as ammonia, but very good work is being done with it in India and in ships trading to the tropics. In fact, it is the refrigerant most commonly employed for ship work. Its critical temperature is 88.43 degrees F. It was supposed for some time that it would not work where water of high temperature only was obtainable. This has however been fully disproved.

It will be noticed that the pressures at which the different refrigerants are worked vary considerably. The working pressures are—for ammonia, in the neighborhood of 40 pounds per square inch in the evaporating coils, and 120 to 170 pounds in the condenser; with carbonic acid, 380 pounds per square inch in



"AUTOMATIC" 3-HORSEPOWER MACHINE WITH ELECTRIC DRIVE.

the evaporator, and 800 to 900, sometimes going very much higher, in the condenser; while with sulphurous acid the evaporator pressures are in the neighborhood of 14 pounds, and the condenser pressures about 45 pounds. It will be seen from the above how the various claims set up by the makers of different apparatus, using the different agents, are obtained.

The high pressure necessary with carbonic acid is easily provided for, by mechanical construction. In the United Kingdom, Messrs. J. & E. Hall, of London, who have made a specialty of carbonic acid machinery, construct the compressor cylinder out of a solid ingot of special steel, the space for the piston, the valves, etc., being bored out with special tools at one setting. Meanwhile the high pressure and small quantity of refrigerant enables smaller compressors to be employed, a matter of considerable advantage in ship work. The makers of sulphurous acid apparatus claim, on the other hand, that their low pressures enable them to work with weaker apparatus. In practice ammonia and sulphurous acid cylinders are of about the same size.

The condenser pressure is really the delivery pressure of the compressor, while the evaporator pressure is the suction or back

pressure of the compressor. The evaporator pressure corresponds to the back pressure of a steam engine, but in contradistinction to the steam engine, it is an advantage to have the back pressure comparatively high, because it means that the gas weighs more to the cubic foot, and therefore more is taken in at each suction stroke. The work of cooling is done mainly by the conversion of the liquid into gas. Some heat is carried off by the refrigerant, after it has become a gas, but this is a small quantity, and though the cooling effect of each cubic foot of the refrigerant, when in the gaseous state, is reduced by the higher pressure and temperature, there is the gain by the greater density of the gas, as explained. As before, it is a question of a balance sheet. There is a critical value beyond which it is not economical to increase the back pressure, because the loss of cooling is greater than the gain by increased density.

LUBRICATION AND STUFFING BOXES OF COMPRESSORS.

The lubrication of compressors is an important matter, just as is that of steam cylinders. For carbonic acid machines glycerine is employed, and for ammonia machines a special lubricant that will not saponify, in combination with the ammonia itself, as nearly all of the ordinary lubricants are said to do. With sulphurous acid, the substance itself forms a good lubricator when pure, but great care must be taken that water is not allowed to penetrate to the cylinder, as then sulphuric acid may be formed, with attendant troubles. Whatever lubricant is employed other than the refrigerant itself a small quantity will mix with the refrigerant and has to be removed before the latter can be again used. For this reason all ammonia and carbonic acid apparatus is fitted with rectifiers, or oil separators, to remove the oil before the refrigerant passes to the condenser.

The separator consists of an iron cylinder having a water jacket, so that its temperature is maintained lower than that of the compressed gas it has to deal with. In the cylinder are fixed baffles of various forms, which arrest the particles of oil, and allow the purified gas to pass on. It is doubtful if the whole of the oil is removed by any of the separators, but a sufficient quantity is taken out to permit the apparatus to continue to run.

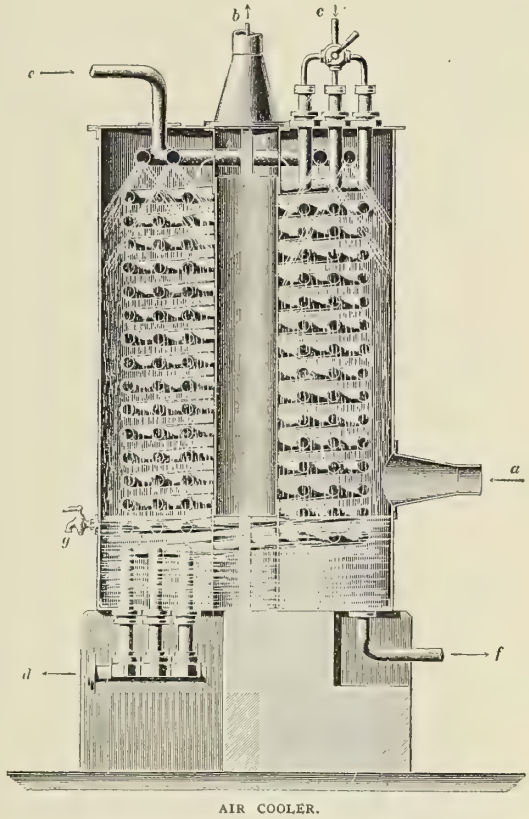
The matter of the stuffing boxes is another very important one. There are two kinds of leakage to be guarded against, that of the refrigerant out of the cylinder, which is similar to a leakage of steam from a steam cylinder, with the addition that the loss has to be made up, and that of air and moisture from outside into the cylinder. Every cubic foot of air that enters the cylinder dilutes the refrigerant to that extent, thereby lowering the efficiency of the apparatus, since a part of the power will be taken up in compressing air instead of the refrigerant gas, and the air will also occupy some of the useful space in the condenser and the evaporator, and may lead to air troubles. With ammonia, also, the refrigerant has such a strong affinity for water that any leakage of moisture into the cylinder may cause a serious loss of efficiency.

For these reasons the stuffing boxes of the piston rods of the compression cylinders are made especially long, and are packed with especial care. Usually the packing is in two sections, a distance piece separating the two, and the packing itself soaked in oil. In some forms of apparatus there is a small reservoir of oil attached to the stuffing box, and the oil is kept by various devices under the same pressure as the condenser. Messrs. J. & E. Hall have a small auxiliary cylinder, the piston of which is exposed, by means of a small connecting pipe, to the condenser pressure, the piston itself acting upon a body of glycerine held in the other part of the cylinder, while the cylinder communicates by another small passage with the stuffing box.

ABSORPTION MACHINES.

At the present time ammonia is the only refrigerant that is employed with the absorption process. The absorption apparatus takes the place of the compressor and its immediate accessories only. There is the same circuit, with modifications that will be mentioned, but the modifications are confined to parts of the absorption plant itself. There are the same condenser and evaporator, as with the compression system, and the same figures for lengths and sizes of pipes for the condenser and evaporator will rule. Also, brine is used with the absorption system, as with the compression system; and, finally, though it is called an absorption system and works by the alternate absorption and expulsion of ammonia it is really a compression system, the compression being produced by the continuous delivery of the ammonia from solution. It is also the same anhydrous ammonia that is employed to charge the machine when starting up.

The operation of the apparatus depends upon the ability of water to dissolve ammonia, whether in the gaseous or the liquid



AIR COOLER.

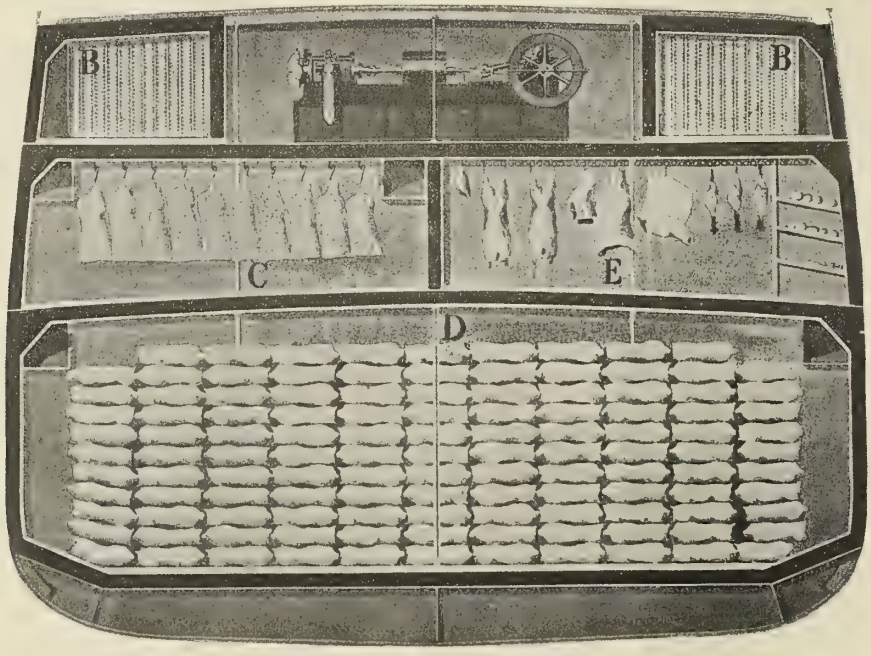
a. AIR INLET. *d.* AMMONIA OUTLET.
b. AIR OUTLET. *e.* BRINE INLET.
c. AMMONIA INLET. *f.* BRINE OUTLET.

condition. This capacity for dissolving or absorbing ammonia varies with the temperature of the water, decreasing as the temperature rises and vice versa. Further, it will be remembered that, when a gas is dissolved in a liquid, it assumes the liquid form, giving up its gaseous latent heat to the liquid.

In the modern absorption apparatus there are two principal vessels, called the generator and the absorber. The generator contains an aqueous solution of ammonia, which is kept as strong as possible, and to which heat is applied, usually by the aid of steam circulating in pipes. The absorber receives the gas which has done its work in the evaporator. The generator corresponds to the delivery side of the compressor, and the absorber to the suction side. The heat applied to the generator, by raising the temperature of the water, obliges it to expel some of the ammonia it holds in solution, the gas passing from it to the condenser, after it has been subject to certain other processes. The continual expulsion of the ammonia gas from the generator raises the pressure behind the gas that is entering the condenser, just as the continuous generation of steam in a boiler raises the pressure in the steam chest and the pipes leading from it. Sufficient compression is produced for the gas to be liquefied in the condenser, as in the compression system.

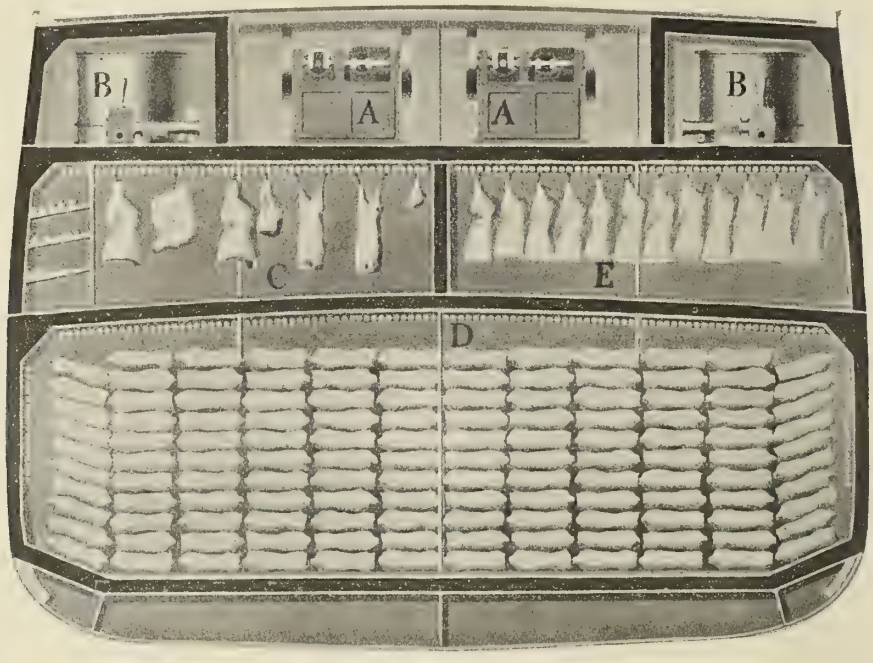
The liquid in the absorber is maintained at as low a saturation and as low a temperature as possible, in order that it may

be able to absorb all of the gas that comes over from the evaporator. In dissolving, the gas liberates the latent heat it possessed as a gas, raising the temperature of the solution. Now it will be evident that unless some arrangement is made for carrying the ammonia over to the generator as it is received, the latter will soon run down. In one form of apparatus that was on the market a short time since, the two vessels, which were in the form of cylinders, were made to perform the offices of generator and absorber alternately, the change being carried out by turning valves arranged for the purpose, after a certain number of hours' work. This arrangement has now been abandoned, and the work goes on continuously, without any change of vessels.



SECTION SHOWING APPLICATION OF AIR REFRIGERATION ON SHIP-BOARD.
a. COMPRESSOR. *b.b.* AIR COOLING CHAMBERS. *c.d.* COMPARTMENTS COOLED BY AIR; *e.* BY BRINE.

The absorber is cooled by water circulating in pipes in the cylinder. Further than this, some of the heat that is not wanted in the absorber is delivered to the generator in an apparatus called the exchanger, which is an accessory to every absorption apparatus. The continual expulsion of the gas by the generator has a secondary effect, in lowering the specific gravity of the liquid. Hence the liquid from which the gas has been driven off tends to fall to the bottom of the cylinder of which the generator is composed. In the absorber the same process is going forward, but in the opposite direction, so pipes are arranged to carry off the weak liquid from the generator to the absorber, and to carry the stronger liquid from the absorber to the generator. These two liquids pass through the exchanger in separate pipes, arranged so that the hot liquid from the generator, which is on its way to the absorber, shall deliver its heat, or as much of it as possible, to the liquid that is on its way from the absorber to the generator. The exchanger, in some forms, includes also some pipes through which cooling water passes, so that the weak liquid may enter the absorber at as low a temperature as possible. But the above does not complete the tale of the apparatus required.



SECTION SHOWING APPLICATION OF BRINE PIPES TO MARINE REFRIGERATION.
a.a. COMPRESSORS. *b.b.* BRINE TANKS. *c.d.e.* COLD STORAGE ROOMS. DARK BANDS SHOW INSULATION.

Marine engineers are familiar with the fact that when steam

is generated, small globules of water pass over with the steam, and give more or less trouble after, if not disposed of. The same thing happens with the ammonia—some water passes over with the gas, in various forms, and must be got rid of, for the reasons already given. For this there are two pieces of apparatus, usually also in the form of cylinders, called the analyzer and the rectifier. The analyzer sometimes forms part of the generator. Both pieces of apparatus are designed to precipitate the water, however carried, and to return it to the generator.

The analyzer consists of baffles of various forms, over which the gas is made to pass on its way from the generator, and which tend to catch any globules of water held mechanically by the gas, these running back into the water from which the gas was expelled. In some apparatus, the rich liquid coming from the absorber is made to run over different obstacles on its way into the generator, meeting the hot gas that is coming away, another exchange taking place, the liquid taking up the water from the gas, and having its temperature increased. The rectifier usually consists of another cylinder, in which the gas is cooled before passing to the condenser. The temperature of the gaseous mixture is lowered to a point below that at which the water held in suspension can exist as vapor, the water being then condensed and running back to the generator.

In the latest form of apparatus made in the United Kingdom, by Messrs. Ransome and Rapier,* the apparatus consists of several cylinders, mounted horizontally, partly side by side, and partly one above the other, the condenser forming one of them. One lot of cooling water answers for the whole apparatus, passing through the different cylinders in succession. There is a small pump employed to carry the ammonia liquid from the absorber to the generator, and there will be a water pump required, where city water under pressure is not employed.

(TO BE CONTINUED.)

*32 Victoria Street, London, W., England.

Salving the George W. Elder.

The floating of the steamer *George W. Elder* on May 22, after she had been half submerged for sixteen months on a ledge of hidden rock in the Columbia river near Goble, was a triumph over difficulties that had long baffled navigators and wreckers of the northwest.

On the night of January 21, 1905, the steamer, while under charter and operated by the Portland & San Francisco Steamship Company, left Portland for San Francisco, carrying 25 cabin and nine steerage passengers, and the usual consignment of freight. The vessel did not answer her helm properly, and the wreck occurred at a point where the river makes a sharp turn. The rock on which the vessel struck is wedge-shaped, and made a jagged hole in her hull just under hatch No. 2, 84 feet from the bow, with the result that she filled with water and gradually settled on the ledge. The passengers were taken off and brought back to Portland, but the cargo, which consisted of 1,100 tons of flour, oats, crackers, tallow, paper and other perishable materials, was a total loss, being insured for about $50,000.

THE DAMAGED BOTTOM OF THE GEORGE W. ELDER, AS SHOWN IN DRY DOCK.

After several unsuccessful attempts to float the vessel the underwriters disposed of the wreck to J. H. Peterson, of Portland, for $10,400. The services of Captain Baker, a successful wrecker from Michigan, were secured on a conditional contract, calling for $30,000 for success; nothing, in case of failure.

His first step, after a thorough investigation of the damage done to her hull had been made by divers, was to build a large cofferdam around the huge hole, which measured 36 by 8 feet, and through which the rock projected 10 feet 8 inches into the hull. The water was then pumped out of the cofferdam, and a cone of cement was built upon heavy canvas spread over the jagged rock in the hold. The cone rendered the forward hold watertight and made the work of raising the wreck possible. The element of doubt was whether the grinding and goring of the rock on which the *Elder* hung balanced would open apertures

in the cone large enough to make the inrush of water from the river greater in volume than that ejected by the pumps.

Before the pumps were started, the steamers *Harvest Queen, Ocklahama, M. F. Henderson* and the tug *John McCracken* were sent for. This wrecking flotilla was later reinforced by the tug *Colwell* of Astoria. The *Henderson* was given the lead tow, making fast to the *Elder's* stern. The *Ocklahama* and *Harvest Queen* made fast to the wreck with lines on the port and starboard bows respectively, in order to draw the bow of the vessel from shore when she righted on her keel and was sufficiently high out of the water to be released from the rocks. The *McCracken* lay astern on the starboard quarter, to keep the stern from swinging inshore onto a neighboring and menacing pile of rocks. The *Colwell's* services were enlisted to aid the donkey engine in supplying steam for the pumps. This network of towlines was reinforced by shore-lines fore and aft, while anchors were firmly set on the port and starboard bows. These precautions were necessary, owing to the swift current.

As soon as the last towline was made fast, the six pumps, throwing streams varying from 6 to 16 inches, soon lowered the water in her hold. Gradually the ship began to right herself from a list to starboard of over 40 degrees, until when released she was nearly on an even keel, though later she settled back with a heavy list, owing to the shifting of the cargo, which the wreckers had no opportunity to trim.

For a time it looked as though the task would have to be given up, for as the water ran lower in her hold new leaks developed around the huge cement cone, and in the plate seams sprung by the goring of the rocks as the wrecked ship swung to and fro in the swift current. The wreckers went to work with renewed energy, and with a final groan the ship glided into deep water in response to the united pull of the towing fleet.

The vessel was first beached off Sand Island, in order that temporary repairs could be made. A few days later she was towed to the Port of Portland drydock, at St. Johns, a few miles below Portland, Oregon, and docked.

The *George W. Elder* was built in Chester, Pa., being launched in January, 1874, from the yards of Roach & Son. She was brought around the Horn for the San Francisco-Portland trade, and has been continually in that service, with the exception of a short time on the Alaska run.

Her length is 250 feet, the beam 38½ feet, and depth 21 feet. She is equipped with new triple expansion engines, and has a gross tonnage of 1,710, and a net tonnage of 1,225. The hull is of iron, with a spar and hurricane deck.

It is estimated that the vessel will cost its new owners $60,400; this includes cost of wreck, $10,400; cost of floating, $30,000; cost of repairs, $20,000. They have been offered $160,000 for her.

C. A. Schafer.

VIEW OF SALVAGE OPERATIONS ON THE STEAMER GEORGE W. ELDER.

CONFESSIONS OF A DRAFTSMAN.

Almost twenty years ago I began to learn the shipbuilding business. I had already had considerable experience in mechanical drawing, and was fairly well advanced in mathematics. I even enjoyed the advantage of possessing the personal acquaintance of a leading ship-yard manager and a few draftsmen of prominence. Up to the present time I have designed a number of vessels and received the credit of one; if hope for a position deferred really maketh the ambitious ill, I ought to be very ill. But I am not.

Strange as this statement may seem to those not familiar with the queer ways of draftsmen, I will state that I began to offer my services with hope; perhaps, to be a little more exact, I ought to say expectation.

There is another reason why I do not look back with discouragement on my failure to have secured a position in keeping with my record and experience. I have found my experience so interesting. Its most interesting features I cannot, unfortunately, reproduce in this article; they would be too personal; they would even betray confidence. Most of all, they would make presidents and managers suspicious of me. In the first place, let me say this for them; they have nearly all been courteous; many of them favored me because they either knew me or knew about me; to others I was simply unknown.

My first experience was with the oldest, and probably the most successfully managed shipbuilding plant (up to four years ago) in this country. After seven years of a thorough training with this company, on many of the finest steam yachts, steamboats, and steamships built on the Atlantic coast, I was offered a position with a firm that had already secured the contract for building two steamers for bay and ocean service, and practically a duplication of vessels on which I had been previously engaged.

Upon my arrival at the new and finely equipped plant, I met the chief draftsman, a very tall and dignified foreigner, who passed through the drawing office so rapidly that his feet scarcely touched

the floor. He appeared to be quite clever, but had no experience whatever on this class of work. With a few exceptions, the heads of the different departments were of the same caliber. Consequently, under this administration, it required two and one-half years to complete these vessels, instead of about eleven months. At the finish, a receiver was appointed for the company, and the yard was closed for nearly five years.

I was much disappointed, but not at all discouraged, with my first experience with a new firm.

I then journeyed farther south, and was employed by a larger concern, which was the successful bidder for building three government vessels. I arrived there on a cold and dreary morning and was introduced to the head of the drafting office, a very courteous, rosy cheeked gentleman, who cross-questioned me as to my past experience, and then, with a confiding smile, related to me his experience on *tug boats*. I remained with this company two years. Seeing no chance for advancement, and the drawing office being filled with college students and house architects, I left, with the following credential, for a more northerly city with seven other draftsmen who were likewise dissatisfied.

"*To whom it may concern*:

"I take great pleasure in testifying to the ability of Mr. * * * as a first class draftsman. He proved himself to be smart, energetic and reliable while with us.

(Signed) * * *.

"Assistant Superintendent Hull Construction."

Then I was employed by a firm that was building three torpedo boats. The chief draftsman at this yard, whom I had met before, was quite tall, handsome, and a good natured gentleman weighing close to 250 pounds. (He has, by the way, risen to be one of our most successful ship-yard managers). He seemed to appreciate my work, and increased my salary two dollars more per week. In all, my experience with this company was exceedingly pleasant. They seemed to be well pleased with my services, from the tone of this note:

"*To whom it may concern*:

"Mr. * * * worked under my supervision for a period of three years, in which time he proved himself an efficient and thoroughly reliable hull draftsman, skilled in detail work and designing. He is also industrious, and can turn out a large amount of work in a short time. I take pleasure in recommending him for any position he may seek as a draftsman.

"(Signed) * * *

"Superintendent of Construction."

While working for this company, I received a letter from a former government draftsman, stating that he would like to see me on a little business matter. I called at his office the following day and found him seated in quite a comfortable looking chair, wearing a very official look, and profoundly impressive. He informed me that he had been recently appointed a constructor, and that he required the services of a draftsman capable of designing a vessel complete. After telling him of my experience, during which time he invariably stroked his mustache, I then presented my credentials, which he read with seemingly intense interest. I was appointed, and reported for duty a week later. This was my first government appointment.

Upon entering the sumptuously fitted office, I was introduced to a very gruff looking old gentleman, who had the rank and title of captain. He was seated close to a large walnut desk, smoking his pipe and reading the morning paper. Looking over his glasses with a very suspicious glare, he shook my hand tenderly, and delivered a few opinions on shipbuilding in a very authoritative manner. I listened attentively, and was then shown to a substantially built drawing board. For three years I worked over this board, and designed three vessels which were a success in every particular. The plans of same were said to be the most complete ever made in this country.

When they were finished, each one had the bold signature of the captain and the constructor in each corner, and then I was told that my services were no longer required on account of having no more work. It was really funny, as the constructor had never designed a boat, and the captain knew about as much of modern constructed vessels as I did about commanding them. To be frank, I was a little depressed, but fortunately was appointed in the Navy Department at Washington. This I expected would be a very good position, and it was.

My work was very interesting and responsible, and I remained there for three years. During that period, I was confronted, one day, by a gentleman who wore a neatly trimmed "van dyke" of unusual prominence, smoking a very black after dinner cigar, and looking quite official. He introduced himself as a ship-yard superintendent, and wished to see me in the corridor of the building. After pacing the floor and gazing at each other strenuously until I was weak in the knees, we came to terms, and I resigned my position to design a cruiser for a private firm. It is needless to say that I was ambitious. This happened to be a great firm; quite new, but with unlimited capital, and situated on the banks of a historical river where the rocks showed their hugeness at high tide. All the officers were fine fellows, and ship building seemed to be an easy thing with them.

In the drawing office, cigarettes and tobacco were sold by the blue print operator. Smoking concerts were occasionally indulged in, and nearly every one appeared as a star. It certainly was the limit. Many contracts were secured at rock-bottom prices, college boys and friends of the officials were learning to be naval architects and marine engineers at fancy salaries, and, in general, it was a good thing.

At the expiration of three months, after working nights and Sundays without extra compensation, I finished the plans of the cruisers. The design was approved by the government, and I was highly complimented by the officials. The president of the company appreciated my efforts, but the superintendent could not see his way clear to retain my services. How true it is that when we think we are impressing people with our superiority, we are nearly always arousing their contempt and disgust. Two years later, this firm failed, its liabilities being over one million dollars.

After a few weeks had elapsed, I was reinstated in the government service once more, but only to remain a short time, when I was again given a very flattering offer to take charge of the drawing office of a firm which was in the hands of a receiver—after chasing success for so long, I could not stop running.

The superintendent of this plant was a hale fellow, well met, and well qualified for the position he held, and we generally agreed on every detail of the construction of all vessels. Three months later the company was reorganized.

The president, while not a ship builder, was a gentleman of great personality and a model of directness. He hit right out from the shoulder and without an apology, too. He seemed to know that a man capable of designing a vessel and asking the management to risk money in building it, ought to be able to take straight talk.

This talk, however, was too straight for the superintendent, and he took a much needed rest. I was then appointed superintendent of the plant, and at once embraced the opportunity of carrying out my ideas of building vessels economically. During the first week I occupied this position, the company was invited to submit plans of a two-hundred-foot steamer to have a speed of sixteen miles per hour, and to be delivered to the owners in seven months. The president was exceedingly anxious that the company should receive the contract, and warned me to be very careful regarding my calculations of cost, etc. The company's plans were approved, and the bid accepted.

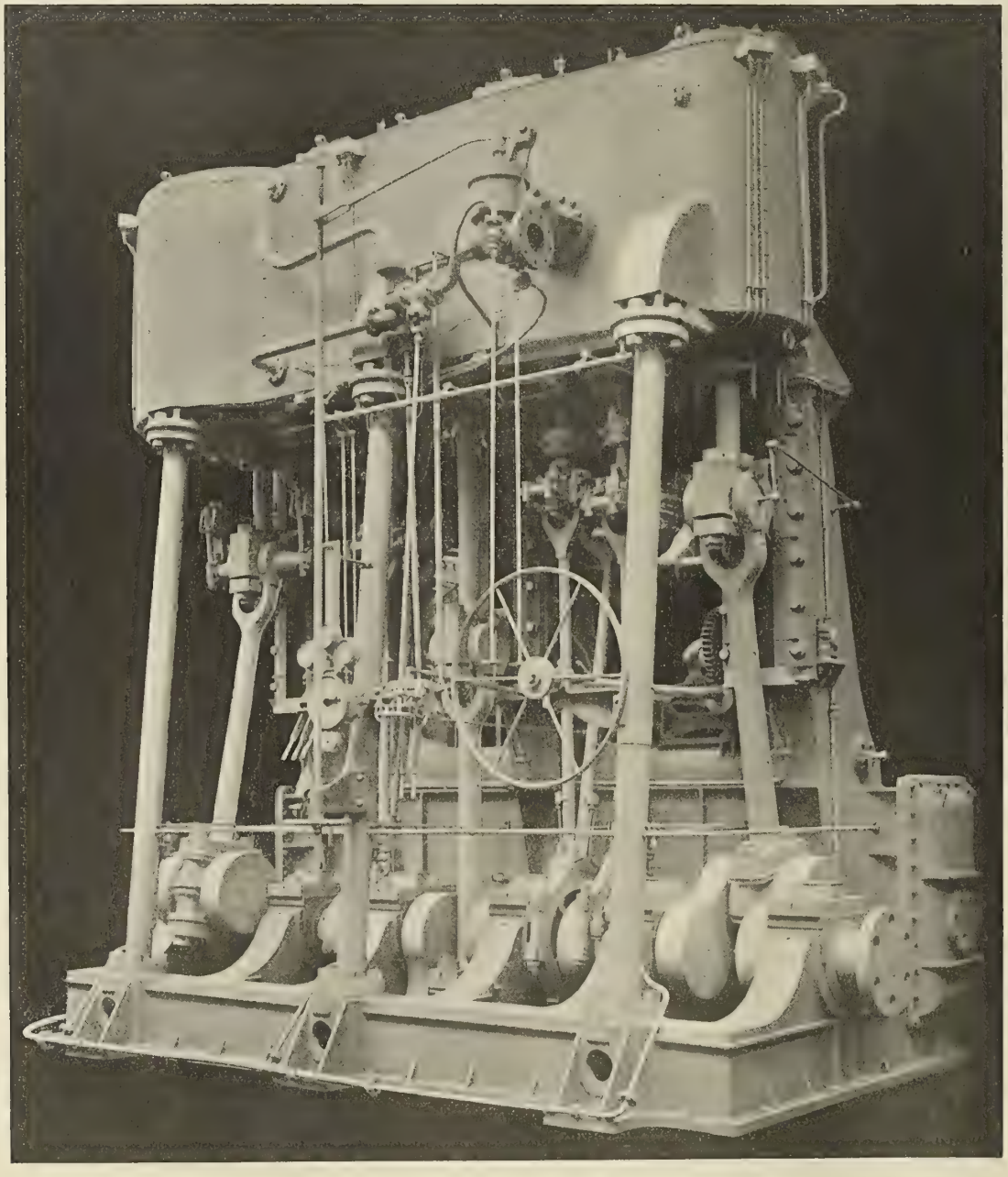
The vessel had to finish on a draft of nine feet aft and six feet six forward, with one hundred and fifty tons of freight on board. During the summer months it was to run on probably the roughest place on the Atlantic coast, consequently was to

roll the least possible, for the comfort of passengers. In six and one-half months from the date of contract, the vessel was turned over to the owners, having met their requirements in every particular. The workmanship was considered first-class in every detail, as the vessel was built under the American Bureau of Shipping Rules for the twenty-year class. The building of a vessel of this class in a ship-yard that was at that time considered as a junk shop, compared with other yards, eclipsed all records regarding time and cost, on the Atlantic coast.

position was transferred to a gentleman of great influence with the president, and I was offered a lower position. This change was not at all agreeable to me, and I resigned. The president seemed to feel sorry, and handed me the following testimonial:

"*To whom it may concern*:

"I take pleasure in recommending Mr. * * * as a hull draftsman of ability and skill and of wide experience for a man of his years in the line of his profession. Mr. * * * was in the employ of the A. B. C. for a year, when he resigned, and de-



MAIN ENGINE OF STEAMSHIP BUXTON, VIEW FROM STARBOARD SIDE, FORWARD.

It was accomplished by employing as few men as possible, all of them being masters of their respective trades and professions, and the abolishing of the "red tape" methods which are now in vogue in our new shipbuilding plants. The drafting office force, which I consider the backbone of every ship-yard, was composed of experienced men; they were paid first-class wages, and their work was eminently satisfactory.

I was complimented by the president on my administration, and promised a block of stock in the company at an early date. I was continually being made such promises, and after working late almost every night and many Sundays for over a year, my

signed the steamer D. E. F., recently built by the company for the G. H. I. Railroad Company of J. K. L., which vessel is a credit to her builders, as well as a satisfaction to her owners. To any firm needing the services of a capable designer and resourceful draftsman, who combines this with celerity in his work, I recommend Mr. * * *.

Very respectfully,

"(Signed)

"President X. Y. Z. Shipbuilding and Dry Dock Co."

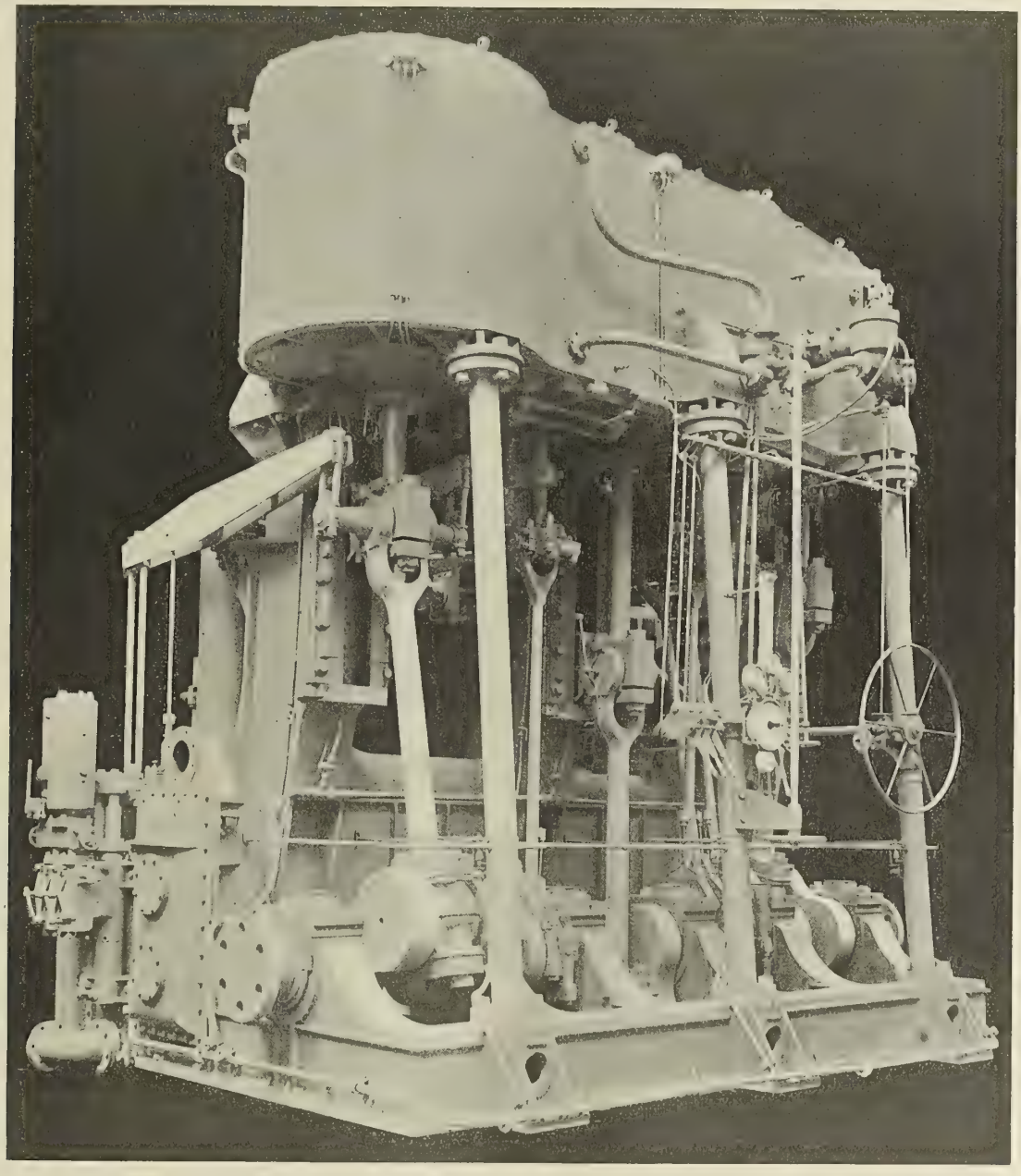
This firm failed eighteen months later.

Shipbuilding at this time was at a very low ebb. I applied to

the various ship-yards for a position, but there were no vacancies. The government, however, decided to build a battleship in a navy yard, and I succeeded in securing an appointment at $1.00 per day less than I received four years previously in the same department. This position was subject to an examination at the expiration of thirty days. I took the examination, being examined by two dashing young naval officers. This examination was attended by thirty applicants and lasted three days. So confusing were the first few questions that twelve draftsmen left the room never to return, and by the evening of the first day, only ten applicants remained. The evening of the second day found me with seven more haggard and worn looking men struggling with problems that we had never used in all the years of our experience. The most distressing scene, however, was a draftsman of over twenty-four years' experience who had held the position of naval architect for eight years with one of the largest shipbuilding companies in this country, at a salary of three thousand five hundred dollars per year. He was tugging along with a launching calculation, and I learned later that he was appointed at $4.48 per diem. Having passed the examination, I worked along under a strain of humiliation. In this office there were many men who had never passed an examination, who did not even possess one credential; one man especially who could hardly speak the English language correctly was receiving one dollar per day more than myself. It was whispered that they had a "pull," and thereby hangs a tale. After the most important work on the battleship had been designed and the material ordered, seven of the best talent resigned.

The famous Shipbuilding Trust offered me a better position in one of its local plants, which I accepted. In a few months I was promoted to the position of chief draftsman. Prosperity seemed to haunt me; I could see visions of a bank account. But not for long. The Shipbuilding Trust failed, and this plant was shut down. I lost my position, and was "down and out."

At times when I reflect on my devotion to my profession, I am so amused that I feel like laughing aloud. I see other men, some of them utterly without experience and without even the faculty of designing a mud scow, and yet pleasing the ship-yards at enormous salaries. I wish that it were in my power to write as enthusiastically of the administration of our ship-yards as I would like to do; but it would take an optimist, indeed, and a base prevaricator at that, to throw a roseate hue



MAIN ENGINE OF STEAMSHIP BUXTON, VIEW FROM STARBOARD SIDE, AFT

over the shipbuilding industry as it stands at the present time.

Shipbuilding in America to-day is stagnant, on account of the inexperienced men who have been introduced into its dealings during the past eight or ten years. This is an adequate explanation as to why receivers have been appointed for many companies. There is exceptional talent in this country, which, if it was placed at the heads of ship-yards, would make them a success; but we find most all of these positions filled by men of little or no experience, influence seemingly being the required qualification. For instance, several of our new ship-yards find no difficulty in explaining results of contracts, because they start out with psychological theories, and determine the results of their methods by a process of reasoning. They state, for instance, if such and such methods are used, such and such results must follow; but the results which they explain by their methods are the products of their own imaginations. When, however, we come into possession of the real facts, we find that they differ widely from imaginary ones, and the result has been bankruptcy.

Throughout the history of American shipbuilding, it is doubtful if there has been one part of the subject upon which views have been so diverse as upon the proper policy with regard to administration of our ship-yards. This has been due to two chief causes; first, a lack of knowledge of the facts, and, second, a genuine difference of opinion with an admitted basis of fact. With regard to the first cause, the facts are in existence, but no one knows them with sufficient breadth or completeness to make possible a really intelligent discussion of the problem, except the practical marine architect and engineer who has been constantly engaged in designing our ships and the details involved in their construction. These men are commonly known as "draftsmen," and the work dependent upon them constitutes the calculations of cost, displacement, stability, speed, etc., as well as the ordering of material. The designing of every ship is a problem by itself, and the draftsman's work is always one of adaptability, while difficulties must be met and overcome in every new contract. Yet they seem to be the least appreciated, and receive comparatively little reward except the satisfaction of well doing when a vessel is a success. The average salary of a draftsman is $3.50 per day. Indeed the managers of many concerns pride themselves upon the fact that the money they have made out of the draftsman's toil enables them to look down upon them as individuals of a distinctly lower grade.

On the other hand, the draftsmen have only themselves to blame for this condition of affairs. They are not organized; hence they are tossed about at the shipbuilder's will from the Atlantic to the Pacific, and vice versa, seldom stopping more than two years in any one ship-yard.

There was a time, five years ago, when a bill was before Congress creating a staff of naval architects. This bill was for the benefit of the draftsmen in the Bureau of Construction and Repair, Navy Department, Washington. Admiral Hichborn, who was at that time chief constructor of the United States navy, testified before the House Committee on Naval Affairs, in behalf of the draftsmen, stating that they were the men that executed the plans for all our warships, and that the bill had his hearty support. But the bill did not become a law, and thereby hangs another tale.

As I have gone on writing, I am afraid I have not maintained the tone of amiability adopted at the beginning of this article. I have a great horror of seeing myself disappointed. However, a disappointed success is far worse than a failure not yet accepted. In the first case, utter hopelessness follows; whereas, with failure resisted, there is always hope. I suppose I am one of those people who never know when they are beaten. Perhaps I was beaten years ago. But, as a matter of fact, no persevering worker is really beaten until he dies or loses his capacity for trying.

C. G.

THE STEAMSHIP BUXTON.

The new steel screw steamer *Buxton*, built by William Gray & Company, Limited, West Hartlepool, for H. Samman & Company of Hull, England, to the highest class in Lloyd's Register, has a length over all of 342 feet, a breadth of 47 feet 6 inches and a depth of 24 feet 9 inches. The ship has a long bridge, poop and topgallant forecastle, with saloon, state rooms, captain's, officers' and engineers' quarters and houses on the bridge deck, and crew accommodations in the forecastle.

THE STEAMSHIP BUXTON ON TRIAL TRIP.

The hull is built with deep frames, and with a cellular double bottom and after peak ballast tank. The equipment includes five steam winches, steam and hand steering gear, steam windlass and donkey boiler, stockless anchors, telescopic masts and all requirements for handling cargo.

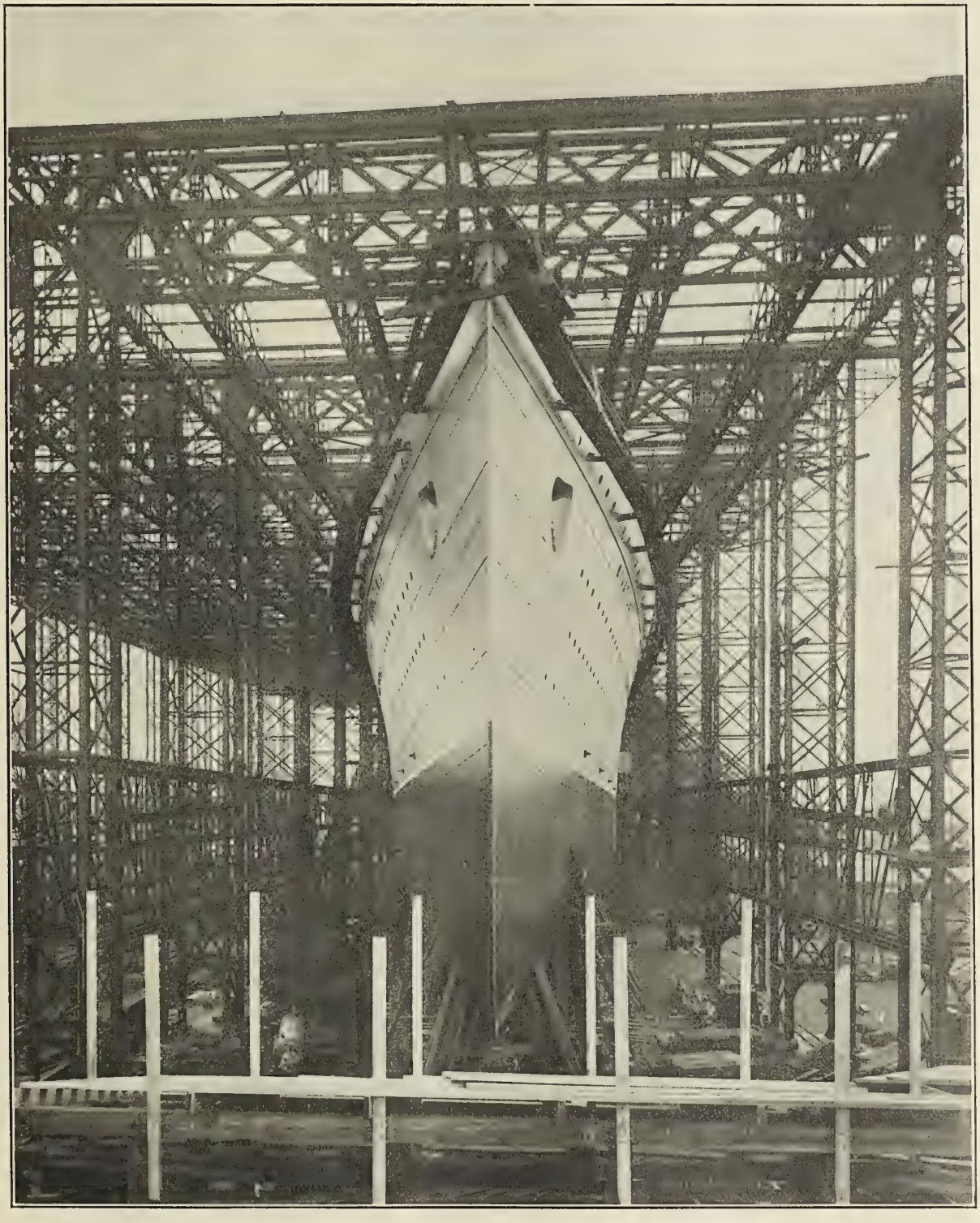
The triple expansion engine, supplied by the Central Marine Engine Works, has cylinders with diameters of 23½, 38 and 64 inches, and a common stroke of 42 inches. Steam at a working pressure of 180 pounds per square inch is supplied by two large boilers. See pages 434 and 435.

The Greater Safety of Alcohol as compared with gasoline for commercial uses is due to the fact that it will not ignite from pure radiated heat as gasoline does; that water will extinguish burning alcohol while it will only spread a fire of gasoline, and that the flame of burning alcohol radiates very little heat while that of gasoline radiates heat very rapidly.

THE NEW CUNARDER MAURETANIA.

BY BENJAMIN TAYLOR.

The second 25-knot Cunarder—the *Mauretania*—launched on the Tyne, Scotland, in September, is sister ship of the *Lusitania*, launched in June at Clydebank, and described in our August number, but there are some notable differences which, although not mentioned elsewhere, may be noted in these pages.



BOW VIEW OF THE MAURETANIA IN THE BUILDING SLIP AT WALLSEND-ON-TYNE.

The *Mauretania* is, for instance, of 6 inches greater depth than the *Lusitania*, and her gross tonnage is 700 tons more, or 33,200 tons, and net 11,900 tons. Her length is the same as the *Lusitania* —785 feet, and her beam 88 feet. She will carry 560 first-class passengers, 500 second-class passengers, and 1,200 third-class. She is 100 feet from keel to sun-deck, and her launching weight was 16,500 tons. The sun deck is the ninth deck, and six of the nine decks are devoted entirely to passenger accommodation. The lower part of the ship is taken up with machinery, stores, etc. The general height between decks is 9 feet, but in the dining saloon, restaurants, cafés, and public rooms it is 10 to 11 feet.

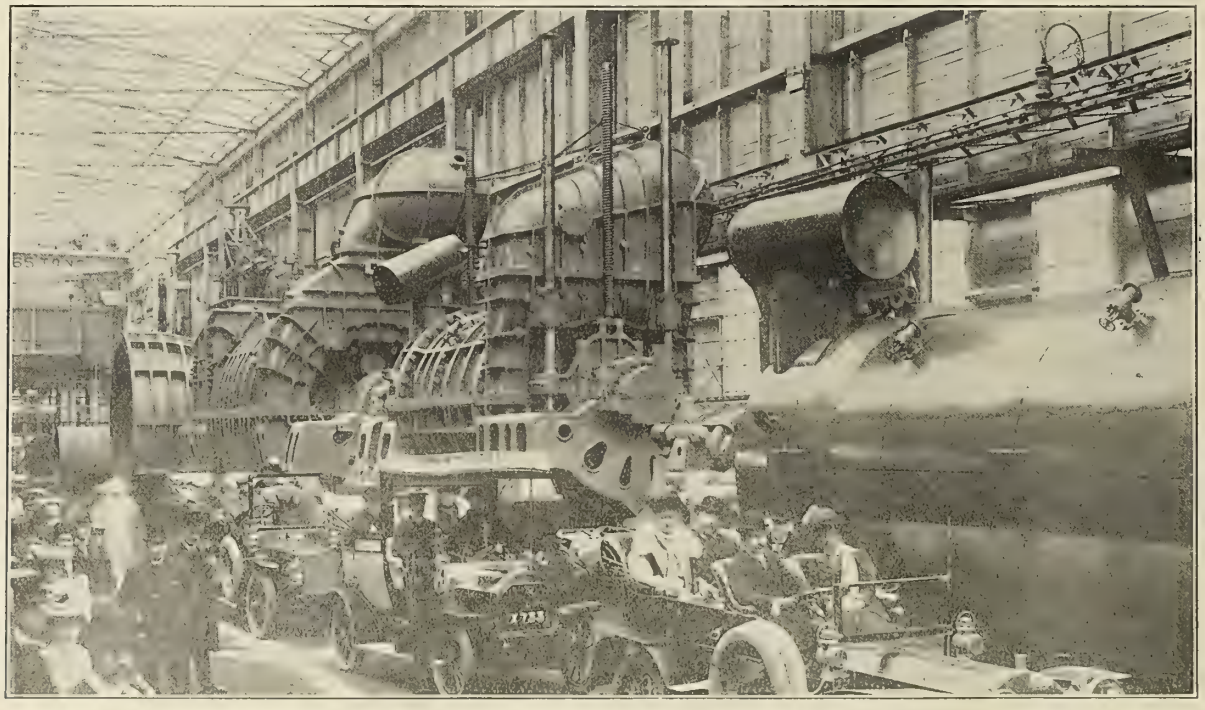
In Atlantic liners the side of the hull amidships inclines inwards towards the top, thus reducing the width of the upper decks. In the *Mauretania*, however, brackets have been formed on the ordinary stanchions, and the promenade decks extend outwards, corresponding to the width at the water line. This promenade space on each side of the deck houses is thus increased to 18 feet.

In general structure the *Mauretania* corresponds with the

Lustitania. The double bottom is 5 feet deep, the bottom is flat, but rounded at the bilge; there are bilge keels 3 feet in depth, extending for a quarter of the length of the vessel. The plating is heavy, some of the plates weighing four tons, and special attention has been paid to strength in the double bottoms and along the sides. High tensile steel has been used, and the joints are covered with heavy straps with eight rows of rivets.

THE SET OF UPSTAKES FOR ONE FUNNEL, AS SET UP IN THE BUILDERS' YARD.

The general arrangement of the turbines corresponds with that in the *Lusitania.* There are four sets, each driving a shaft with a single three-bladed propeller, differing, however, in proportion from those of the *Lusitania.* The two outer shafts, which turn inwards when going ahead, are fitted with high-pressure turbines; the two inner shafts, which turn outwards, have low-pressure turbines, and also have the astern turbines, which are entirely separate from the ahead turbines. In the turbines of the *Mauretania,* a further difference is to be noted in the material used. The casings throughout are of cast iron, but the rotors and their disk ends are forged of Whitworth's fluid compressed steel. The high-pressure turbine is 26 feet in length. The astern casing is entirely separate from the low-pressure casing, and the adjustment block is between them. The rotating mass in the low-pressure and astern casing is over 200 tons, and is arranged to enable an adjustment of 1/3000 inch to be made. The maximum peripheral speed is 10,000 to 11,000 feet per minute, with a minimum clearance of 1/10 inch in the high-pressure turbine between the blades and their proximate surface. Each low-pressure turbine weighs 430 tons, and the rotor has a diameter, bare, of 15 feet 9 inches. With blades in place, the diameter is 19 feet 3 inches.



MAURETANIA TURBINES: HIGH PRESSURE AT RIGHT; ASTERN IN CENTER; LOW PRESSURE AT LEFT.

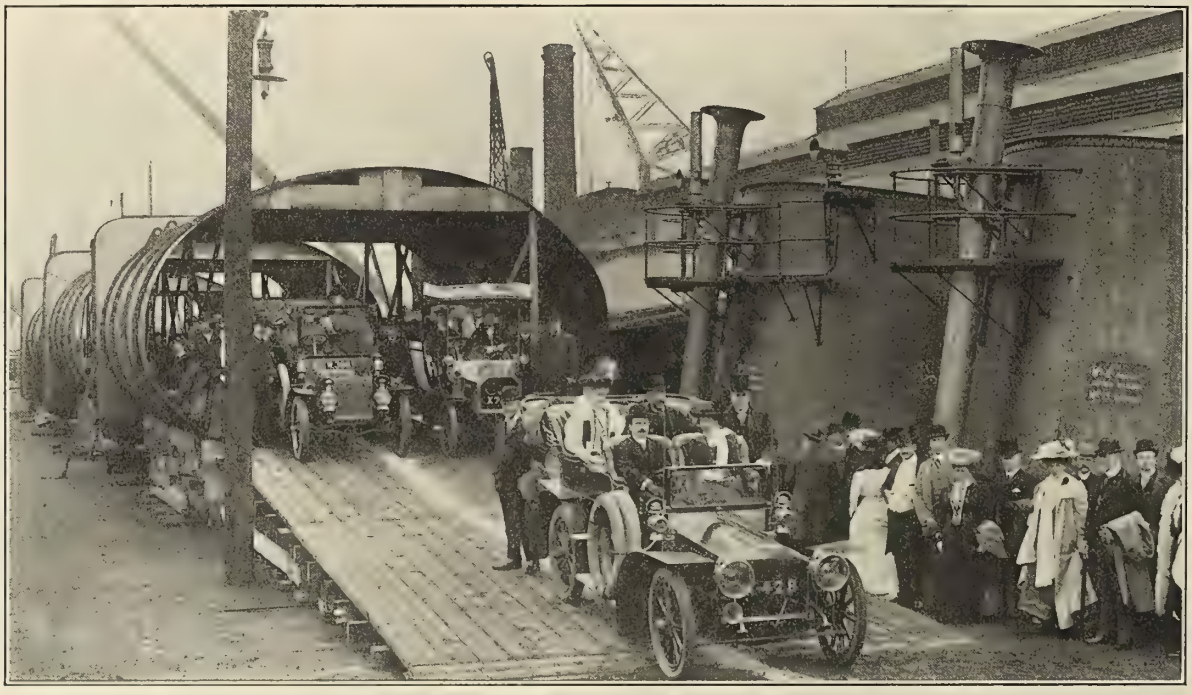
We described the method of fixing the turbine blades in the *Lusitania.* In the *Mauretania* a different method has been followed. The Parsons method, as adopted on the *Lusitania,* is to

fix each blade separately into the grooves turned on the inside surface of the circular casing and on the outside of the round rotor. Each blade is separately wedged in position by a calking piece. In the *Mauretania* engines the blades were fitted into a curved plate, formed so that a series of ten plates constituted a complete ring for either the casing or the rotor; the blades are wedged into the plate, and the ten segments making up the complete ring are in turn wedged into the groove formed in the casing or rotor. Before being placed in the casing or rotor the blades on the plates are bound and laced together at the upper end. A binding strip is fitted into indents formed on the edge of the blades, and around this and the blades there is laced a wire to secure them together, the whole being soldered. The blades in the *Maurctania's* turbines increase in length from 2½ inches, where the steam is at highest pressure, to 23 inches, where it is at lowest pressure, the expanding steam requiring an increased length of blade to effectually rotate the blades on the rotor. The details required for the adjustment of the turbines to insure the most efficient minimum clearance between the blades and the adjacent surfaces correspond with those adopted on the *Lusitania*.

STERN VIEW OF THE MAURETANIA SHORTLY BEFORE LAUNCHING, SHOWING THREE OF THE FOUR PROPELLERS.

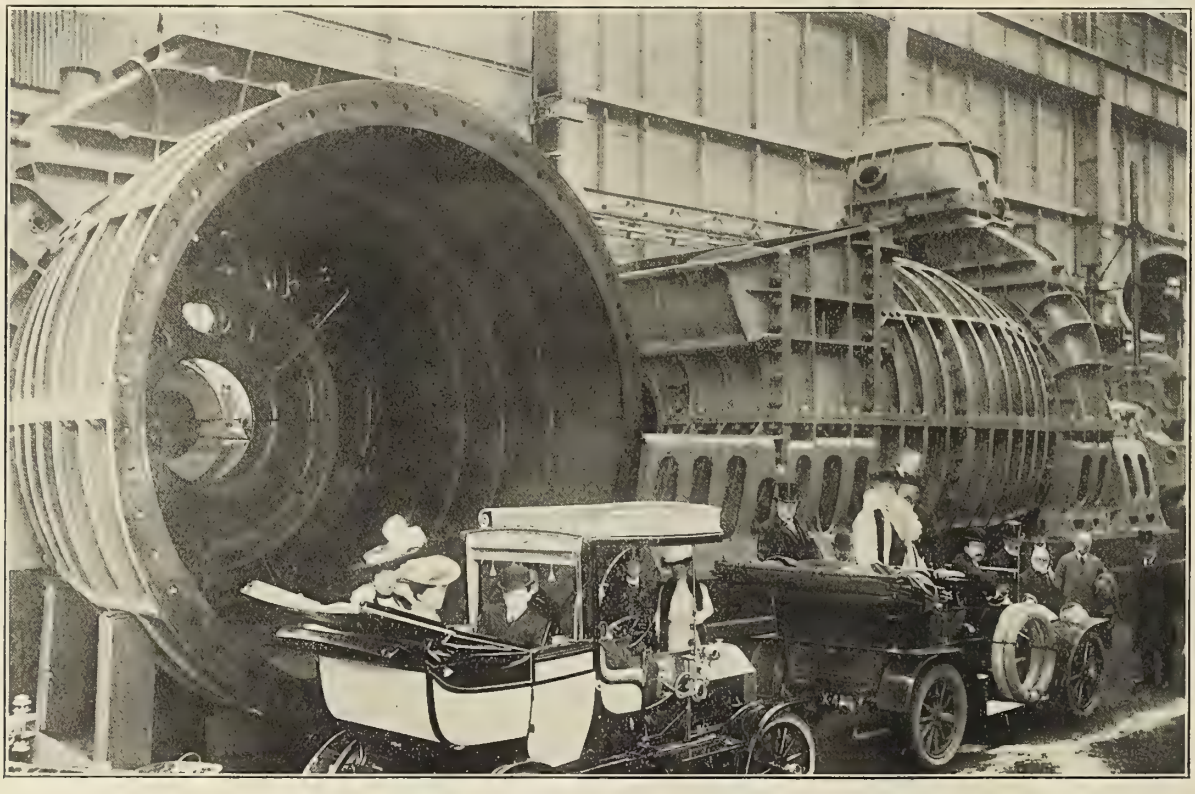
The auxiliary machinery has been supplied mainly by Scotch firms. Messrs. G. and J. Weir, Limited, Glasgow, supply the feed, air and other pumps, some of them being of immense size. They are fitting in the *Mauretania* thirty-seven pumps, for a variety of duties, also feed heaters. Messrs. Howden & Son have made the forced-draft gear. The windlass and capstan gear is by

Messrs. Napier Brothers, Glasgow, and is of massive proportions. The steering gear, with the engine on the tiller head, is by Messrs. Brown Brothers, of Edinburgh. Many of the heavy castings were made in the Glasgow district.



MOTOR CARS PASSING TWO ABREAST THROUGH A SECTION OF ONE OF THE FUNNELS.

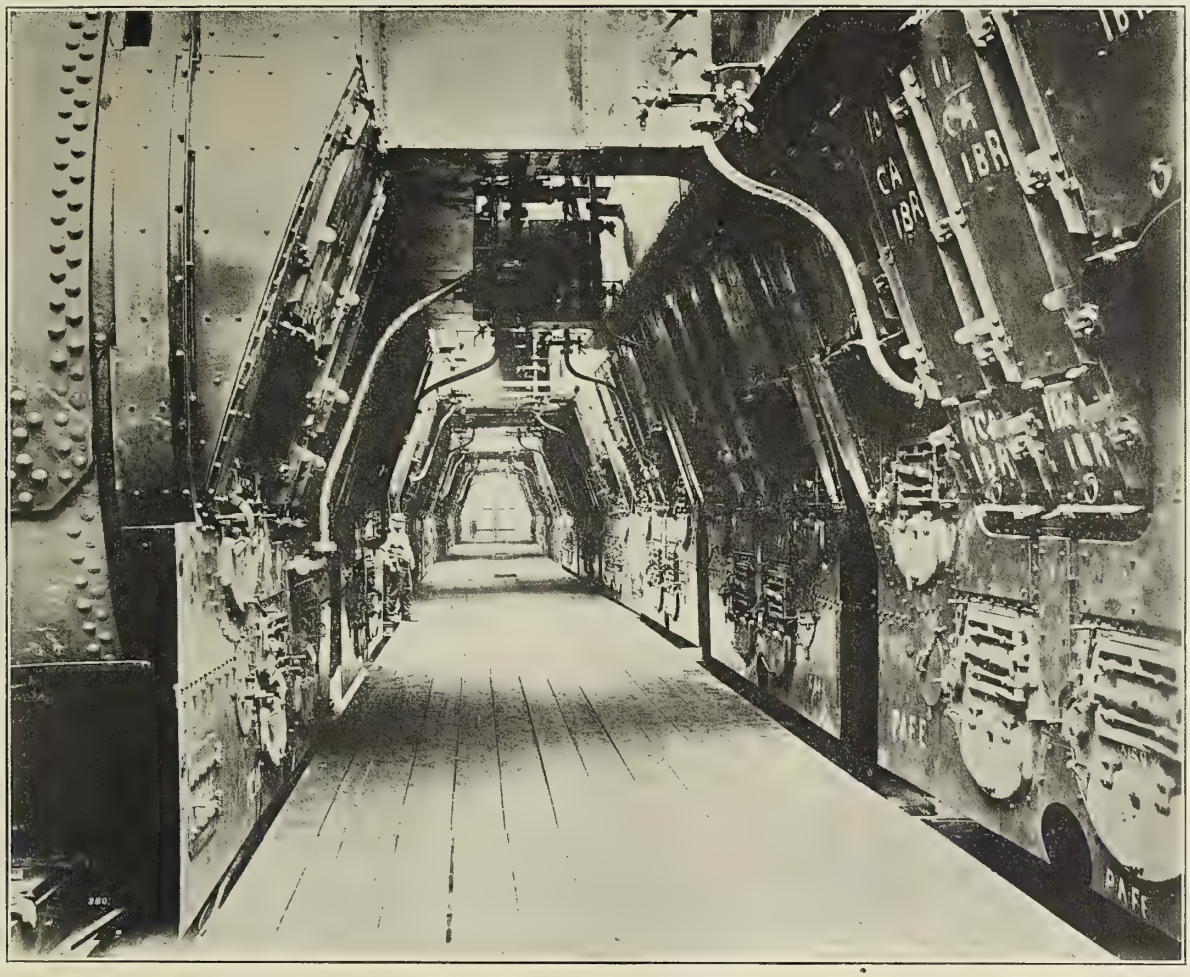
The boilers of the *Mauretania* are twenty-five in number. Two are single-ended, while the others are double-ended with four furnaces at each end. The steam pressure is 200 pounds to the square inch. The boilers are to be worked under Howden's system of heated draft, and the fans will be operated by electric motors. The boilers are arranged in four groups, and for each group there is a funnel, elliptical in shape and 22 feet in diameter. The tops of the funnels are 150 feet above the level of the keel. There are 4,000 square feet of grate area and 160,000 square feet of heating surface in the boilers, to develop the 68,000 to 70,000 horsepower required to attain a trial speed of 25¼ knots, and the 24¾ knots guaranteed speed on the Atlantic. This speed is a quarter of a knot in excess of that guaranteed by the Cunard Company under their agreement with the British government.



LOW PRESSURE CASINGS FOR MAURETANIA TURBINES, SHOWING EXHAUST NOZZLES.

The builders of the *Mauretania*—Messrs. Swan, Hunter and Wigham-Richardson, Limited, Wallsend-on-Tyne, are an amalgamation of Messrs. C. S. Swan and Hunter, Limited (dating

from 1872) and Messrs. Wigham-Richardson and Co., Limited (founded in 1860) with the Tyne Pontoons and Dry Docks Company, Limited. The works cover an area of seventy acres, and have a river frontage of 4,000 feet. The berth on which the *Mauretania* was built is covered in, 740 feet long, with a width inside of 100 feet, and a height of 140 feet. Under the roof there are a large number of electric traveling cranes.



PART OF THE BATTERY OF SCOTCH BOILERS SET UP IN SHOP. NOTE THE MAN AT LEFT.

The turbine machinery has been built by the Wallsend Slipway and Engineering Company, Limited, a concern founded by a combination of shipbuilders to provide the machinery for the vessels constructed at their works. It is equipped with a slipway and a repairing dry dock, and some years ago the directors of the Wallsend establishment secured as manager Mr. Andrew Laing, long connected with the Fairfield Engineering Works, Glasgow. Immense engine and boiler shops were thereafter constructed by Sir William Arrol and Co., Glasgow, without interfering with engineering operations. The output of the concern now averages about 70,000 horsepower per annum, and three large marine boilers per fortnight. Naval machinery is constructed, as well as the best mercantile engines.

The Engineering and Machinery Exhibition.

From September 15 to October 17 an exhibition was held at Olympia, London, England, covering in general engineering and machinery of all descriptions. The President of the exhibition was Sir William H. White, late Director of Naval Construction of the British Navy, and other marine men noted among the patrons included: Sir Philip Watts, the present Director of Naval Construction; Sir Edward J. Reed, a former Director of Naval Construction; Sir John I. Thornycroft, Vice-Admiral Sir J. Durston, R. N.; Hon. C. A. Parsons, past President of the Institute of Marine Engineers; Lord Pirrie, Chairman of the Harland & Wolff Company; Sir Marcus Samuel, President of the Institute of Marine Engineers; and John Inglis the past President of the Institute of Marine Engineers.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports under date of September 11, 1906, the following percentage of completion of vessels building for the United States Navy:

			Aug. 1	Sept. 1
BATTLESHIPS.				
Nebraska	19 knots.	Morgan Brothers Co.	96.	96.38
Georgia	19 "	Bath Iron Works	98.43	99.6
Connecticut	18 "	Navy Yard, New York, N. Y.	97.6	99.08
Vermont	18 "	Fore River Shipbuilding Co.	90.5	92.7
Kansas	18 "	New York Shipbuilding Co.	85 8	87.
Minnesota	18 "	Newport News Co.	93.68	95.
Mississippi	17 "	Wm. Cramp & Sons	60.83	62.18
Idaho	17 "	Wm. Cramp & Sons	59.	60.29
New Hampshire	18 "	New York Shipbuilding Co.	50.3	51.8
ARMORED CRUISERS.				
California	22 knots.	Union Iron Works	94.6	95.
South Dakota	22 "	Union Iron Works	92.4	93.
North Carolina	22 "	Newport News Co.	53.87	57.18
Montana	22 "	Newport News Co.	47.66	51.03
SEMI-ARMORED CRUISERS.				
St. Louis	22 knots.	Neafie & Levy Co.	99.22	100.
Milwaukee	22 "	Union Iron Works	97.9	98.5
SCOUT CRUISERS.				
Chester	24 knots.	Bath Iron Works	40 8	44.97
Birmingham	24 "	Fore River Shipbuilding Co.	41 8	44.9
Salem	24 "	Fore River Shipbuilding Co.	42 6	45.
SUBMARINE TORPEDO BOATS.				
Cuttlefish	.....	Fore River Shipbuilding Co.	81.7	84.9
Viper	.....	Fore River Shipbuilding Co.	69 3	73.
Tarantula	.....	Fore River Shipbuilding Co.	81.3	85.9
Octopus	.....	Fore River Shipbuilding Co.	65.1	69.9

TRIAL OF THE BATTLESHIP NEBRASKA.

The standardization runs of the *Nebraska* took place July 16, 1906, over the measured mile course of Vashon Island, Puget Sound, beginning at nine o'clock in the morning and ending at twelve-forty. The weather was overcast and misty, with a smooth sea and a light breeze from the south.

The draft was measured both before and after the trial, and was found to be as follows:

	Before	After.
Forward	23 ft. 10⅝ ins.	23 ft. 6⅝ ins.
Aft	24 ft. 0⅝ ins.	23 ft. 10⅞ ins.
Mean	23 ft. 11⅝ ins.	23 ft. 8¾ ins.
Corresponding displacement...	14,985	14,815
Mean displacement during trial	14,900	

The results are given in the accompanying table and curve and show a maximum speed of nearly 20 knots. These curves have been plotted separately for the runs with and against the tide, the curve of true speed being midway between the other two. From this latter it was deduced that a mean of 119.85 revolutions per minute were required for the contract speed of 19 knots.

Number and direction of run	Elapsed times observed.	Mean revolutions per minute.	Speed in knots.
1—N	3—07.8	121.710	19.169
2—S	3—05.15	122.639	19.444
3—N	3—08.83	124.078	19.063
4—S	3—04.35	119.389	19.528
5—N	3—12.95	125.372	18.658
6—S	3—00.4	124.296	19.956
7—N	3—19.63	115.729	18.033
8—S	3—03.8	119.975	19.587
9—N	3—22.3	111.228	17.795
10—S	3—29.0	98.849	17.225
11—N	3—34.1	104.060	16.815
12—S	3—28.8	100.157	17.241
13—N	3—51.6	92.563	15.544

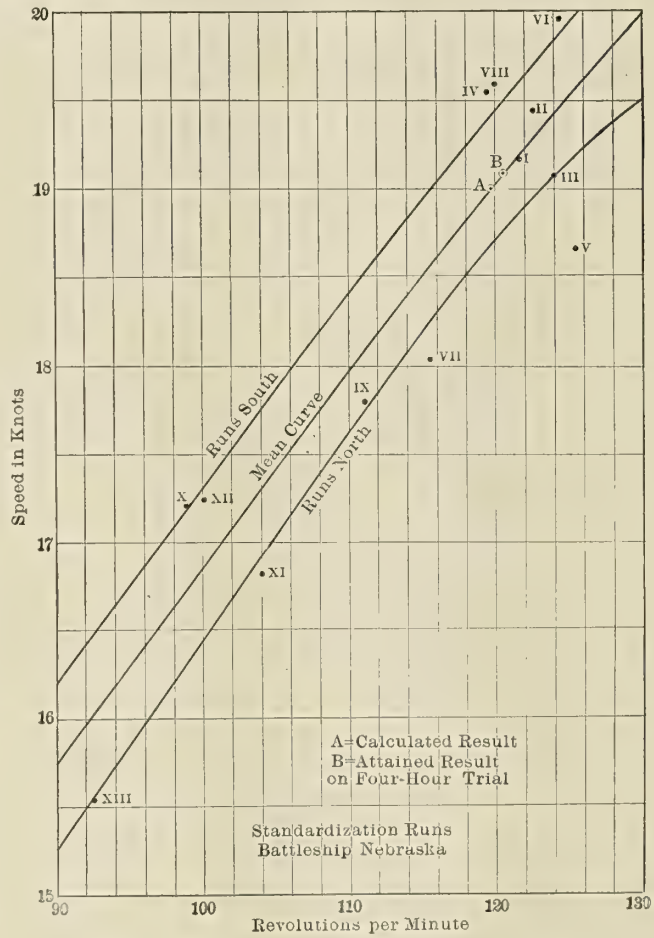
On July 17 the four-hour full speed trial was run, the draft at the beginning being, forward, 24 feet 1¼ inches; aft, 23 feet 9¾ inches; mean, 23 feet 11½ inches; with a corresponding displacement of 14,975 tons. As the vessel made a straightaway run, it was not feasible to obtain the draft at the end of the trial, but it was estimated that at the middle of the trial the draft was 23 feet 9½ inches, corresponding with a displacement of 14,865 tons.

The trial, which began at 8.29 a. m., was run in a smooth sea with light breezes from the south, the ship steering northwest by west. The data for this run are included in the table and log herewith.

Hour of day. h. m.	Mean revolutions per minute. Starboard engine.	Port engine.	Both engines.	Corresponding speed by revolutions.
A. M				
8—29	(Beginning of run).			
8—44	121.5	119.6	120.53	19.070
8—59	122.2	119.0	120.56	19.071
9—14	122.8	120.8	121.78	19.181
9—29	122.9	119.9	121.41	19.140
9—44	123.6	121.6	122.60	19.257
9—59	123.0	120.	121.50	19.160
10—14	122.1	119.2	120.68	19.080
10—29	123.4	117.8	120.60	19.072
10—44	120.7	116.9	118.81	18.905
10—59	120.8	116.8	118.81	18.904
11—14	121.6	116.6	119.07	18.930
11—29	123.0	119.4	121.87	19.190
11—44	122.6	118.9	120.72	19.085
11—59	121.7	118.1	119.9	19.012
P. M.				
12—14	121.7	118.1	119.9	19.012
12—29	121.5	118.0	119.72	18.990

After completing the 4-hours' full-power trial, and while the vessel was still under forced draft, the steering gear was tested in the following manner: The helm was put hard-a-port (35 degrees) in 10.4 seconds; the time to swing her through 360 degrees with full helm was 3 minutes 40 seconds. The helm was then shifted from hard-a-port to hard-a-starboard in 16.8 seconds by the bridge indicator. The helm was then put amidships in 8.4 seconds. The maximum heel was 3 degrees, and the estimated diameter of the turning circle was 350 yards.

After completing the above tests of the steering gear, the helm was put amidships and after the vessel had gathered full headway of her course, the steam reversing gear of the main engines was reversed, the engines being started astern, and after they began to work astern at full speed, they were brought to full speed ahead.



REVOLUTION—SPEED CURVE FROM STANDARDIZATION RUNS.

After the fires had been reduced sufficiently to keep the steam pressure under control, the helm being amidships, the engines were reversed; and when making 60 revolutions per minute astern, the vessel was allowed to gather sternboard for two minutes; the helm was then put 15 degrees starboard, then 25 degrees port, then 30 degrees starboard, then 35 degrees port, then 35 degrees starboard, and allowed to remain at each of these angles for two minutes. The helm was then put amidships. During these tests the general operation of the steering gear was satisfactory.

The weight of machinery, including water in the boilers, condensers, etc., is shown by the report of the inspector of machinery at the contractors' works to be 1,681 tons.

The working of the machinery, both main and auxiliary, and its performance during the trials, was satisfactory except the priming of boilers caused by leaky tubes in main condensers. The boilers steamed freely and worked otherwise in a satisfactory manner throughout the trials. A careful observation and inspection

THE BATTLESHIP NEBRASKA, BUILT BY THE MORAN BROTHERS COMPANY, MAKING 19.51 KNOTS ON TRIAL TRIP
(Copyright, W. P. Romans, 1906.)

of the various parts of the machinery during and after the trial showed the engines, boilers, and appurtenances to be in excellent condition.

The following is a summary of the observations recorded in the log during the four-hours' trial:

	Starboard.	Port.
Average revolutions per minute, four hours.	122.19	118.78
Mean revolutions per minute, both engines.	120.49	
Maximum steam pressure at boilers, in pounds	285.3	
Average steam pressure at boilers, in pounds.	271.3	
Maximum steam pressure at engines, in lbs.		
H. P. steam chest	257.	251.
Average steam pressure at engine	250.	238.
Maximum air pressure in fireroom	2.03	
Average air pressure in fireroom	1.55	
Maximum vacuum, each engine	25.	25.5
Average vacuum, each engine	19.5	25.2
Collective I.H.P. of all main engines	20,946.8	
Collective, main engine, air, circulating, feed, and hotwell pumps	21,282.8	
Collective, main, and all auxiliary engines in operation during trial	21,910.6	
Kind and quality of coal used on trial, Cardiff, coarse screened	excellent.	
Average pounds of coal used per hour during trial	61,991.	
Pounds of coal per hour used per horsepower by main and all auxiliary engines in operation during trial	2.83	
Speed of ship in knots	19.06	
Slip of propellers in percent of their own speed	17.023	14.453

A NEW ZEALAND MEAT-CARRYING STEAMER.

BY BENJAMIN TAYLOR.

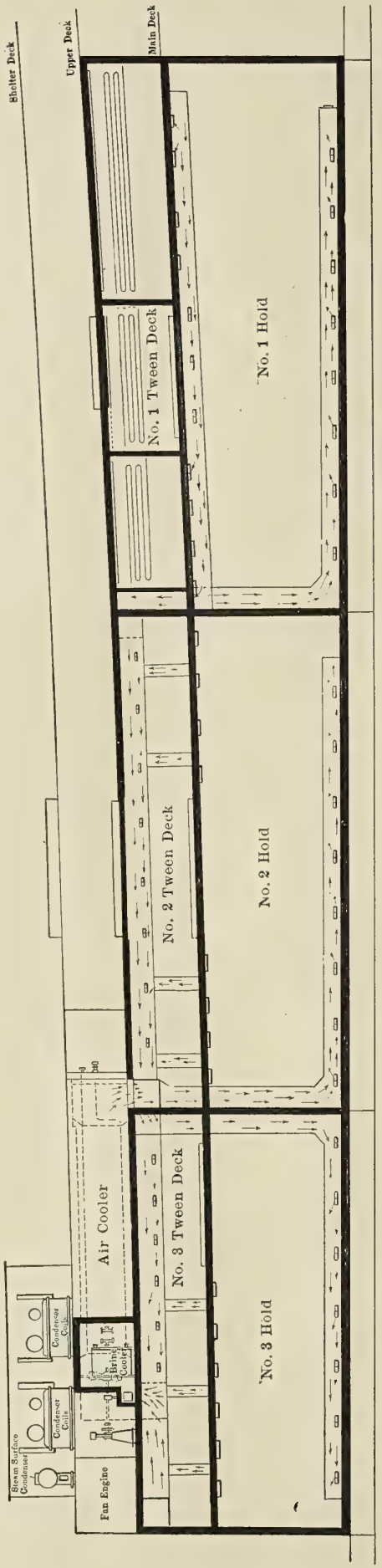
The twin screw steamer *Orari*, built by William Denny & Brothers, Dumbarton, for the New Zealand Shipping Company, is in many respects a notable and interesting vessel. Her principal dimensions are; length, 460 feet; breadth, molded, 60 feet, depth, 34 feet.

She is primarily intended for the New Zealand Shipping Company's extensive frozen meat trade from New Zealand to Great Britain, and the entire fore end of the ship is insulated in the holds and lower 'tween decks. One of the 'tween decks is divided into sections and refrigerated by brine pipes, which enables variations of temperature to be obtained suitable to the various classes of perishable cargo. The remainder of the cargo spaces are cooled by means of air driven through coil rooms, which are kept at a low temperature by the expansion of compressed ammonia.

The *Orari* has five hatchways, each of which is fitted with powerful cargo gear, with great outreach over ship's side. The stretch which the derricks possess permits cargo to be discharged direct into trucks without intermediate handling—an economy appreciated by consignees. There is also a large steel derrick at No. 2 hatch, for heavy lifts to be handled without shifting the vessel up to shore cranes.

Although not intended primarily for passenger service, the vessel has a few roomy and well-ventilated cabins provided for passengers. This accommodation, and that for the officers, is situated under the bridge deck. Owing to her great freeboard, the vessel is fitted with two flying bridges, one above the other, from the uppermost of which the sea can be seen close up to the bow. The steering is controlled from either bridge as desired. The vessel is fitted throughout with electric light, the installation being by the builders.

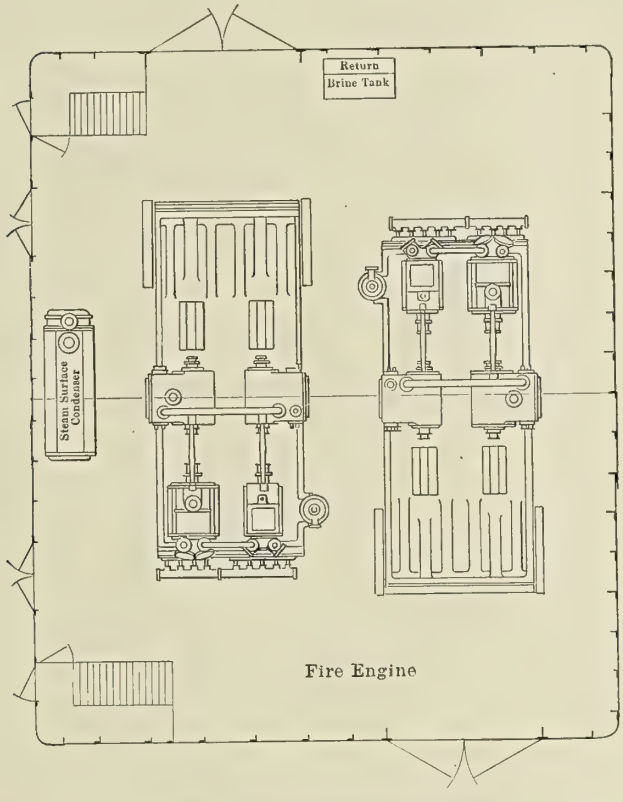
The propelling machinery consists of two sets of triple expansion engines, having cylinders 24½, 41¼ and 69 inches in diameter, with a stroke of 4 feet. The high and intermediate-pressure



LONGITUDINAL SECTION SHOWING THE AIR COOLED HOLDS AND 'TWEEN DECKS, AND THE BRINE COOLED NO. 1 'TWEEN DECK, OF STEAMSHIP ORARI.

cylinders are fitted with piston valves, the low-pressure being fitted with the usual multiple ported flat valve, with Joy's balance piston. In addition to the ordinary lubricating arrangement, fitted as a stand-by, the Axiom system is installed. The pistons are of steel, cast of cone shape to give the necessary strength. The piston rods are of forged mild steel and the glands, which are fitted with metallic packing, have rack and pinion gear for uniform adjustment. The connecting rods are of ingot steel, and, like the piston rods, are interchangeable throughout.

The valve motion is of the Stephenson type, with very large wearing surfaces. The reversing gear is of the all-round type, the reversing engine being itself reversible. The crank shafts are built of best ingot steel in three pieces, the material standing not only the Board of Trade and British Corporation tests, but also a series of special fatigue tests. The crank shafts also are interchangeable throughout. The bedplates are of strong cast iron, the main bearing bushes being fitted with plastic white metal.



PLAN OF REFRIGERATORING ENGINE ROOM.

The air pumps, which are worked by levers off the intermediate pressure cylinder, are of the Edwards type, with brass chambers, buckets, valves and valve seats. The circulating pumps are of the independent centrifugal type, one fitted to each condenser, but so arranged that each pump may serve both condensers if desired.

The boiler feed arrangement consists of two feed pumps on each engine, discharging into a separate tank draining to float tank, or direct to boilers as may be desired. When the former alternative is being employed two independently driven feed pumps are used, each of which can draw from float tank, condenser, or reserve feed tank, and discharge to the boilers, or circulate the water in the boilers when steam is being raised. These pumps are also available for pumping out the boilers when required.

The condensers are built of plate steel, with brass tubes and tube plates, having large cooling surface. The auxiliary condenser is capable of dealing with the exhaust from all deck and auxiliary machinery when the vessel is in port, and two large evaporators are fitted in the engine room for making up loss of feed.

The propellers have bosses of cast iron, with four adjustable bronze blades.

There are five cylindrical boilers working under forced draught on the Howden principle, each boiler having three Morison suspension type furnaces. The uptakes are led into a double-cased funnel, which has been specially arranged to suit the limitations imposed by the Manchester Ship Canal. Owing to the great length of the voyages in the New Zealand trade, the vessel has a very complete outfit of spare gear, tools and engine room outfit.

The refrigerating plant is supplied by the Haslam Foundry and Engineering Company, Limited, of Derby. It consists of two horizontal compound ammonia compression refrigerating machines, each driven by compound steam engine, combined on a massive cast iron bedplate, mounted on steel box containing the condenser coils, these being placed in a spacious engine room on the shelter deck, with a Haslam steam surface condenser supported on A-frames, with direct steam driven air and feed pump.

Each refrigerating machine is capable of performing the whole of the work of cooling the holds and 'tween decks with the air-blast system for the carriage of frozen mutton. No. 1 'tween deck is arranged with brine piping for the carriage of either chilled meat or dairy produce, as desired.

The air ducts and trunks are arranged so that the blast can be reversed in case of need. The brine coolers are fitted in the upper deck below the refrigerating engine-room in an insulated chamber, and are arranged to work at two distinct temperatures. Vertical duplex brine pumps are fitted, each capable of doing the whole of the work, and the water circulating pump for ammonia and steam condensers is placed in the main engine room.

The accompanying profile drawings show the several insulated holds and 'tween decks in relation to the air blast batteries, and brine room and refrigerating engine room on shelter deck. We also produce a plan showing the arrangement of the refrigerating machines, steam condenser, and return brine tank.

Shipping Losses, First Quarter of 1906.

Lloyd's Register reports the loss between January 1 and March 31, 1906, of 185 vessels of an aggregate of 163,519 tons. Of this list, 177 vessels of 158,526 tons represent the losses sustained by the fourteen principal maritime nations, as separately listed in the return. Of this total, 75 vessels of 99,369 tons were propelled by steam and 102 vessels of 59,157 tons by sail. It will be noted that the average size of the steam-propelled vessels is 1,325 tons, as against an average of 1,576 tons for the steam vessels owned by the nations in question. The sailing vessels lost average 580 tons, against 584 tons for the total. The average size of all the vessels lost is 896 tons, as against 1,222 tons for the total number of vessels owned. It should be noted that no vessels under 100 tons are included in the report.

Under the head of steam vessels, the number lost is 0.43 percent of the total number in service, while the tonnage lost was 0.36 percent. In the sailing vessels the number lost was 1.06 percent and the tonnage 1.05 percent. The total losses included 0.65 percent in number and 0.48 percent in tonnage. It will be noted from these figures and the comparison between the average sizes of vessels lost and the average of vessels owned, that the losses come in general from the small types of vessels. This, of course, is only what could have been expected, because the larger the vessel the better able she is usually of weathering conditions which would destroy smaller craft. It is both the losses of the smaller type of vessel, and the rapidly increasing size of the average new vessel built, that are accountable for the increasing average size of ships in service in the various mercantile fleets.

Propeller Performance of the Indiana.

BY LIEUT. H. C. DINGER, U. S. N.

The United States battleship *Indiana,* at her last docking, had her propeller blades changed. The propellers are three bladed and are arranged to turn outboard in going ahead.

The old blades gave the following dimensions:

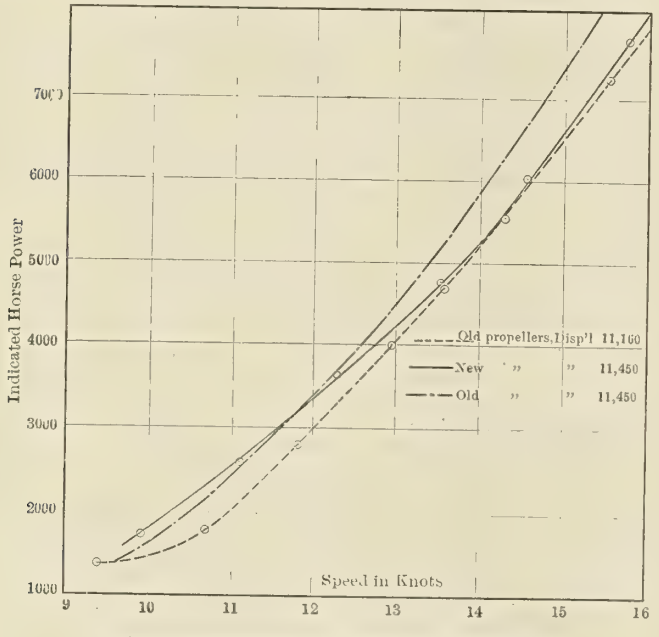
Diameter ..... 15 feet 6 inches
Helicoidal area for each propeller .....53.9 square feet
Pitch set at .....16 feet

The new blades gave the following:

Diameter ..... 15 feet 6 inches
Helicoidal area of each propeller.....75.6 square feet
Projected area of each propeller.....64.3 square feet
Pitch set at .....16 feet 3 inches

The vessel was standardized with the old blades February 26, 1906, at Guantanamo. The results were plotted in curves of revs -speed, revs-I. H. P. and speed-slip. From these curves the data in the table are taken. The displacement was 11,160 tons; draft, forward, 25 feet 1 inch, aft, 26 feet 7 inches, mean, 25 feet 10 inches.

The vessel was standardized with the new blades July 17, 1906,



SPEED—POWER CURVES, OLD AND NEW PROPELLERS.

at Provincetown. The displacement was 11,450 tons; draft, forward, 25 feet 8 inches, aft, 27 feet 2 inches, mean, 26 feet 5 inches. The results are likewise plotted in curves of revs-speed, revs-I. H. P. and speed-slip. From these curves the data in the table are taken.

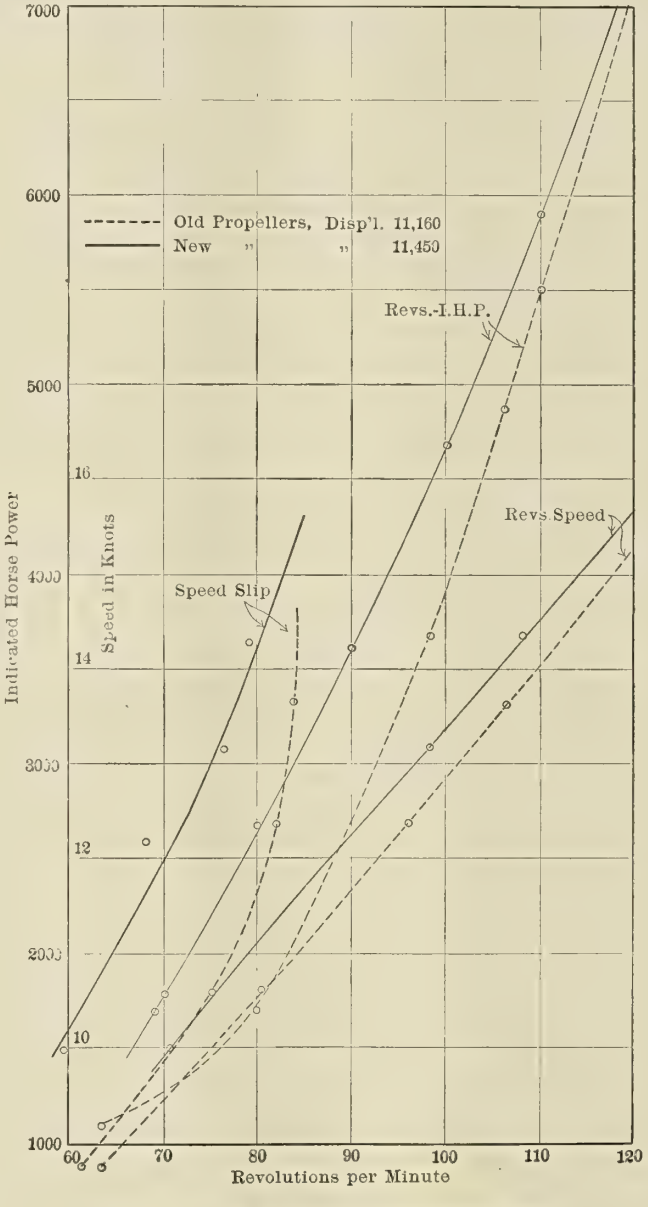
The highest speed actually run on the standardization was 13.6 knots for the old blades, and 14.43 for the new. The results for the high speeds in the table are taken from the extension of the curves beyond the actual points obtained.

Revolutions	Horsepower		Speed, Knots		Slip, Percent	
	Old	New	Old	New	Old	New
70	1,300	1,550	9.4	9.8	14.2	12.
80	1,700	2 700	10.7	11.1	16.3	12.5
90	2,800	3,600	11.8	12.3	17.6	15.2
100	4,000	4 700	12.9	13.5	18.3	16.7
110	5,500	6 000	14.2	14.5	18.5	17.9
120	7,250	7 400	15.5	15.75	19.	19.5

From these two tables were plotted the accompanying speed—I. H. P. curves. They would show the comparative efficiency of the two sets of blades.

The displacement was slightly less when the old blades were standardized, namely, the difference between 11,450 tons and 11,160 tons. The time out of dock was about the same. If the difference of displacement is taken into account on the basis that power varies as $\left(\frac{D}{d}\right)^{\frac{2}{3}}$ then the third curve will be obtained. The vessel was higher forward when the new screws were tried. This may have had some effect in giving slightly better results.

The changes made consist in increasing the area and the pitch. This has resulted in a general decrease in slip, a falling off in



SPEED—REVOLUTIONS AND POWER—REVOLUTIONS CURVES.

efficiency at slow speeds, and an increase in efficiency at the higher speeds. This is similar to the results obtained by changing the propellers of the *Charleston.*

It is believed that in this case the area was increased somewhat too much, and that the pitch should not have been increased beyond 16 feet. While the old blades were quite deficient in area, the new ones may be considered to have somewhat too much area and pitch, which produce greater frictional losses. The new blades have made a considerable change in the starting and stopping of the vessel, which can now be stopped in 360 yards.

An Interesting Old Patent.

A patent issued in 1788 by King George the Third, of England, dealing with the application of the steam engine to the propulsion of vessels and of vehicles, reads as follows:

To all to Whom These Presents Shall Come, we, Robert Fourness and James Ashworth, of Elland, in the Parish of Halifax and County of York, Gentlemen, send greeting.

Whereas, His Most Excellent Majesty King George the Third did, by his Letters Patent, bearing date the fourth day of March in the——year of his reign give and grant unto us the said Robert Fourness and James Ashworth, during the term of years therein expressed, should and lawfully might use, exercise, and vend, within England, Wales, and the Town of Berwick-upon-Tweed, our Invention of *"A New Invented Machine for Working, Towing, Expediting, and Facilitating the Voyage of Ships, Sloops, Barges, and other Vessels upon the Water, Whereby the Conveyance of Goods will be Rendered more certain as to the Time upon the Water;"* in which said Letters Patent there is contained a proviso obliging us, the said Robert Fourness and James Ashworth, under our hands and seals, to cause a particular description of the nature of our said Invention, and how the same is to be performed, to be enrolled in His Majesty's High Court of Chancery within one calendar month next after the date of the said recited Letters Patent, as in and by the same, relation being thereto respectively had, more fully and at large appear.

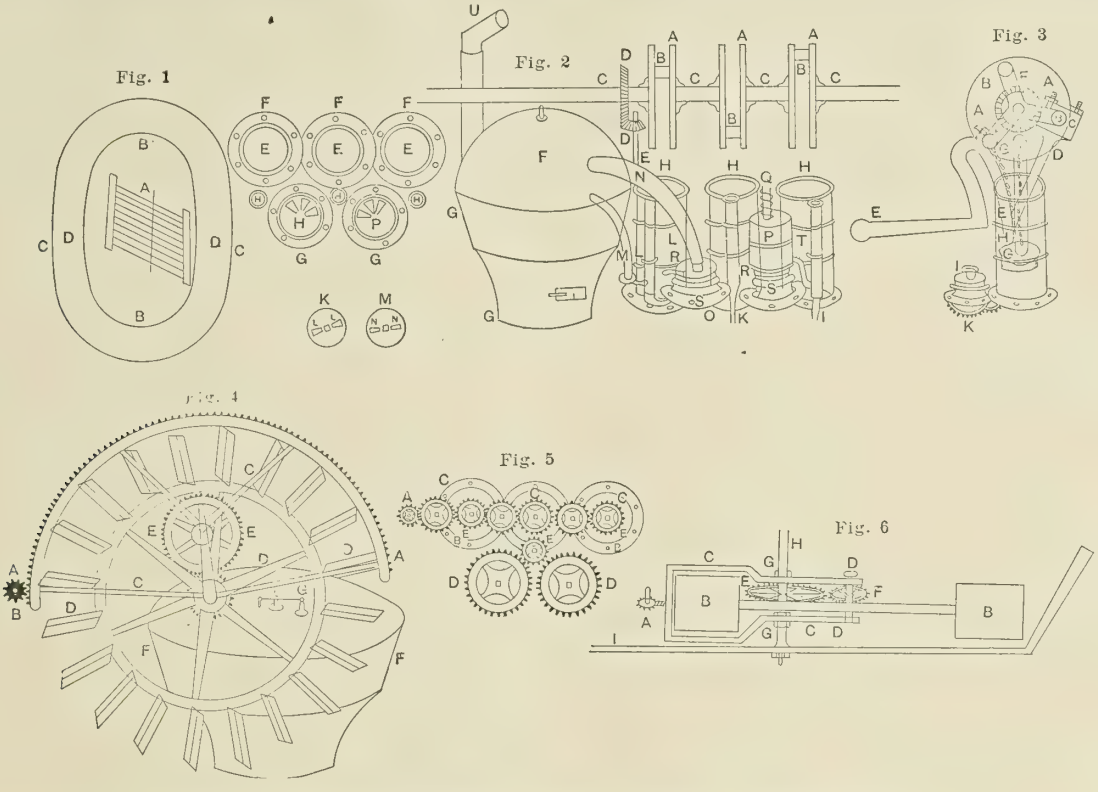


DIAGRAM OF A MARINE STEAM BOILER AND ENGINE, PATENTED IN ENGLAND IN 1788.

Now Know Ye, that in compliance with the said proviso, we, the said Robert Fourness and James Ashworth, do hereby declare that our said invention of a new machine for expediting and facilitating the voyage of ships, sloops, barges, and all other vessels upon the water, is described in manner following, the steam or fire engine being the principal of power:

Fig. 1, the ground plan of the steam or fire engine; *A*, the grate on which the fire is lighted; *B,B*, the shape of the boiler bottom; *C,C*, the case in which the boiler stands; *D,D*, flew round the boiler for the flame to pass through; *E,E,E*, three steam cylinders; *F,F,F*, three flanges by which the cylinders are extended to their bottoms. N. B.—A single cylinder or any number of cylinders may be used in place of the three here specified. *G,G*, two regulators, the one for steam, the other for the injection water; *H,H,H*, three force pumps; *I,I*, a box into which the steam is received from the boiler, and in which is placed a metal plate with three holes in, through which the steam is admitted into each cylinder through a pipe leading from each hole, and a metal plate which regularly revolves upon the face of the plate *I,I*, in the box, by a spindle passing from the wheel *D* in Fig. 5, to regulate the admission of steam alternately into the cylinders; *P*, another plate, with three holes in, placed in the box which receives the injection water from the cistern, *P*, as described in Fig. 2, on which revolves by a spindle passing from the other wheel *D* in Fig. 5, in the same box, the plate *M* with two holes in as *N,N*, to regulate the injection of condensing water in the cylinders.

Fig. 2, *A,A,A*, six wheels fixed upon the spindles *C,C,C*, between which are fixed three round bearing studs, as *B,B,B*, situated as described by *B,B,B*, in Fig. 3. A crank in various forms may be applied for the same purpose as those six wheels *A,A,A*, are applied. *D*, a cog wheel fixed on the spindle *C,C,C*, which gives motion by the nut upon spindle *E* to the wheel *A* in Fig. 5, upon the bottom of the same spindle *E*. *F*, the crown of the boiler in which the steam is generated; *G,G*, the case in which the boiler stands; *H,H,H*, three steam cylinders; *I*, a force pump that raises water for injection into cistern *P*; *K*, a force pump for the use of keeping ship or vessel dry; *L*, another force pump by which a sufficient quantity of hot water is raised to replenish the boiler through the pipe *M*; *N*, the steam pipe; *P*, the cistern into which the injection water is forced; *Q*, the rod of the piston of the injection cistern, to which is added a spiral spring which gives force to the injection; *R,R*, two winches on the lower end of which are fixed two valves or cocks by which the steam or injection water are entirely shut off from the cylinders at pleasure; *S,S*, the two boxes in which the regulating plates described by *R* and *M*, in Fig. 1, work; *T*, a valve to let out the superfluous water from the force pump *I*; *U*, the chimney of the furnace.

Fig. 3, a side view of one cylinder and its apparatus; *A,A,* one of the wheels in which the studs *B,B,B,* in Fig. 2 are fixed; *B,B,B,* three studs to which the rods are connected, as described, by the rod *D,* and are connected by the coupling boxes *C,* which rod is joined to the beam *E,E,* at letter *H; F,* a cog-wheel as described by *D* in Fig. 2; *G,* the piston and rod, showing the chains by which the working beam and piston are connected; *I,* one of the boxes mentioned in Fig. 1, which contains the regulators; *K,* one of the wheels by which the regulators are actuated.

Fig. 4, a side view; *A,A,* a semi-circular rack and pinion by which the working or driving wheel *D,D,D,* is raised out of or lower'd into the water, as the burthen of the vessel may require; *E,E,* a cog-wheel fixed on the end of the spindle *C,C,C,* in Fig. 2, which gives action to the wheel *F* in Fig. 6, on whose spindle the working or driving wheel *D,D,D,* is fix'd; *F,F,* the boiler in which the steam is generated; *G,G,* a safety valve and weight fix'd in the top of the boiler.

Fig. 5, a flat section of the wheels used in the regulation of the steam and injection; *A,* a nut upon the bottom of the spindle *E,* in Fig. 2, which gives motion to all the other regulating wheels; *C,C,C,* six wheels of equal diameter; *D,D,* two wheels fixed on the bottom of the spindles of the regulating plates as described by *K,M,* in Fig. 1; *E,E,E,* three wheels fixed severally under the center of the bottoms of the cylinders, in the center of each of which wheels is fixed a hollow cock pin, which lets out of the cylinders the hot water, air, etc., after each stroke made by the piston. N.B.—Any other gear applicable to the steam engine may be used instead of the gear here specified.

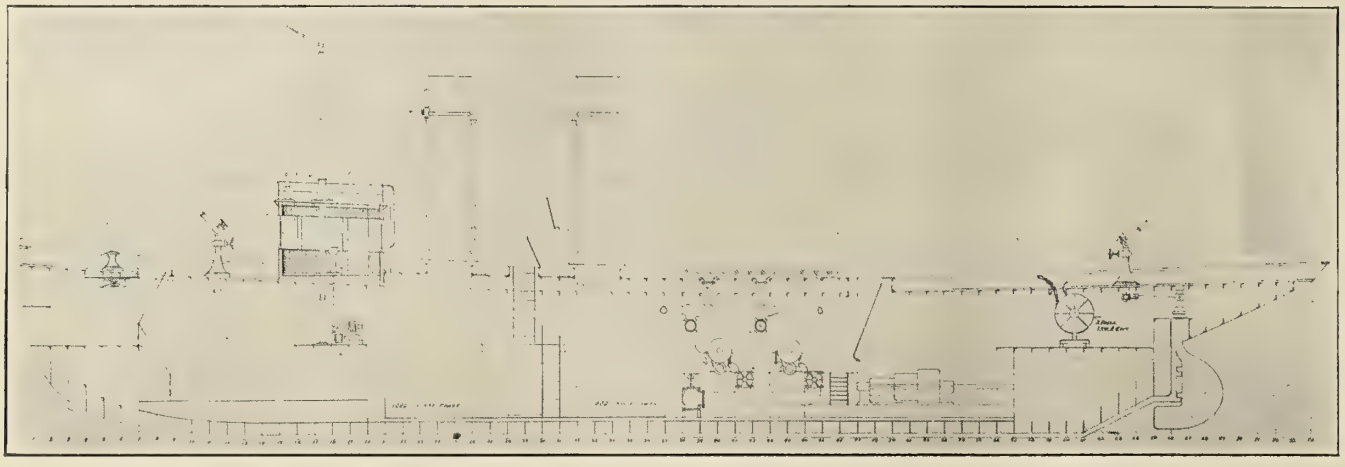
Fig. 6, a flat section of the working or driving wheel on one side of the vessel, and its apparatus; the same sort of wheel, and apparatus to force it, being applied on the other side of the vessel also. *A,* a rack and pinion described by *A,A,* in Fig. 4, *B,B,* the floats of the working and driving wheel. N.B.—The working, driving, or rowing wheels may be made in various forms; one alone may be applied, or any plurality; oars also may be applied, in lieu of the working, driving, or rowing wheels. *C,C,* a frame in which the working, etc., wheels are fix'd and rides upon the axis of the spindle *D,D,* on which is fix'd the wheel *F,* which gives motion by the action of the wheel *E* fix'd upon the spindle *H,* as described by *C,C,C,* in Fig. 2; *G,G,* the two bearings on which the frame of the working wheel *B,B,* rests; *H,* the spindle described in Fig. 2, under *C,C,C,*; *I,I,* a rail intended for the safeguard of the working, driving, or rowing wheel or wheels.

In witness whereof, we, the said Robert Fourness and James Ashworth, have hereunto set our hands and seals, this Twenty-ninth day of March, One thousand seven hundred and eighty-eight.

Robt. Fourness (L. S.)
James Ashworth (L. S.)

And Be It Remembered, that the said Robert Fourness and James Ashworth came into the Court of our said Lord the King in his Chancery, and acknowledged the Specification aforesaid, and every matter and thing therein contained and specified. And that the Specification aforesaid was duly stamped according to the tenor of the Statute in that case made and provided.

Inrolled the Second day of April, in the year last above mentioned. —*Power.*



INBOARD PROFILE OF REILLY TURBINE PROPELLED FIRE BOAT, WITH TURBINE DRIVEN CENTRIFUGAL PUMPS

Preliminary Designs for a Fire Boat.

The hull is to be of the flush deck type, the general design to be as shown. It shall be constructed of steel throughout; shall be made of ample strength to withstand ramming at full power into ice; and so shaped that it can be successfully maneuvered in ice as well as in open water. It shall have a speed of 18 knots; the five pumps shall be of sufficient capacity to discharge 8,000 gallons of water per minute, at a pressure of 200 pounds per square inch; it shall be lighted throughout by electricity, including an 18-inch search light projector.

The principal dimensions are:

Length over all	150 feet
Length between perpendiculars	132 feet
Breadth molded	25 feet
Depth molded	16 feet
Draft, normal	10 feet
Displacement, normal, about	450 tons

MACHINERY EQUIPMENT.

Propelling Engines.—The propelling machinery shall consist of two marine turbines, each driving an independent shaft and screw; the total horsepower shall be about 1,800.

Boilers.—The boiler plant to consist of two Babcock & Wilcox water tube boilers, of sufficient capacity to furnish steam for 2,000 horsepower, the steam pressure to be 200 pounds per square inch.

Fire Pumps.—The fire pump equipment to consist of four turbine driven centrifugal pumps, each pump to have a capacity of 2,000 gallons per minute at a pressure of 200 pounds per square inch, or a total capacity for the four pumps of 8,000 gallons per minute.

Fire Outfit.—To have one hose tower with a 3-inch nozzle, tower to be universal acting, to have a maximum hoist of 68 feet; two 4-inch monitor nozzles located as shown; twenty-four 3½-inch hose connections, arranged so as to be available for service on either side of the ship.

Quarters for Crew.—Bath and toilet rooms only to be supplied on board ship.

Deck Outfit.—To be complete, as required by the City Fire Department and the United States Inspectors of Steam Vessels.

Special Features.—A special feature of this design is in the

construction of the hull, which enables the hose connections to be used for service on either side of the ship. Another feature is the hose or water tower, with which arrangement a stream can be thrown into the hold of a vessel, or over the deck of a vessel into the hold of another vessel, or over or into a warehouse alongside of a wharf.

General Design.—The aim of the whole design has been to incorporate the most successful features and ideas of the various fire boats that have been built in this and other cities, and to incorporate such features as experience has proved to be desirable. Special stress has been laid on the arrangement of the fire and steam mains; for the first, so that a clear unobstructed deck may be had for the handling of hose and equipment; for the second, that an ample steam supply can be had at all times, so that the apparatus can be worked to its full capacity, without causing priming, etc., and that an ample supply of water can easily be fed to the pumps without causing water hammer, air pockets, or other features which are detrimental to the successful operation of the boat as a fire fighting apparatus. Ability is given to have vessel under headway within two minutes after alarm.

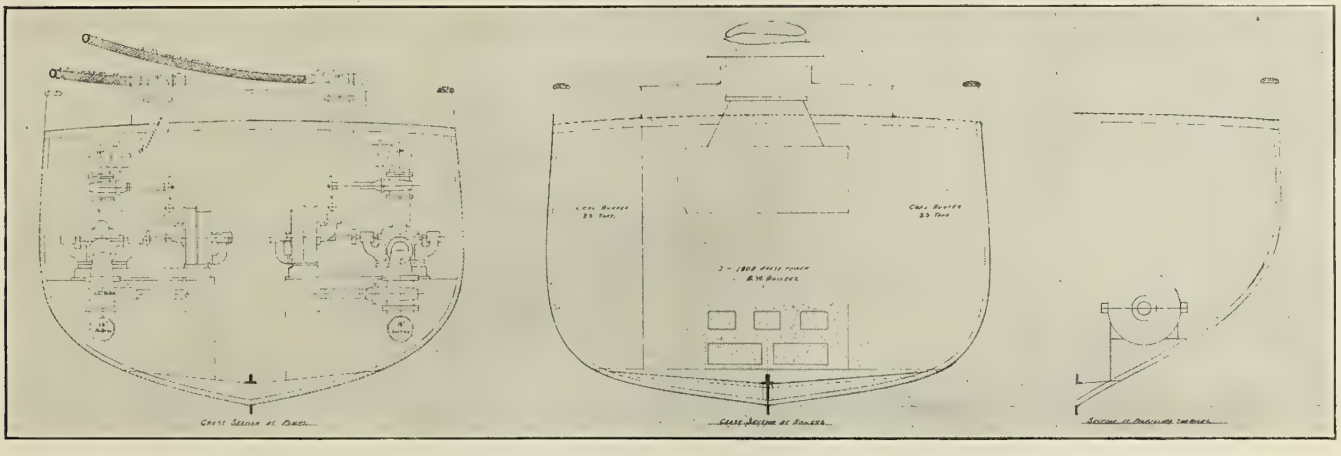
It is said that at no time, unless for extraordinary repairs to boilers or hull, would it be necessary to lay up longer than six hours for repairs to pumps or engines, and that the speed of 18 knots obtainable with this design would be impossible with the old type of reciprocating engines and pumps, displacements being equal.

Fire Pumps.—In the fire pumps a decided departure has been made from the usual duplex double acting reciprocating pumps. Instead of these it is proposed to install four centrifugal turbine driven pumps, for the following reasons. The turbine pumps deliver the water at constant pressure, this eliminates the forces of the hose pulsations (which are due to the reciprocating pumps) and enables the pipemen to handle with ease a line of hose that would be an impossibility with the old style of pump, again, the pumps turning with a uniform speed makes the requirement for steam uniform at the boilers, thus priming and the lifting of water at the boilers is eliminated.

The pumps consisting of four units, any two can be under repair, and still leave a good apparatus in commission; the turbines and pumps being light and of standard design, an extra steam and water wheel could easily be carried on board, and in case of breakage, repairs to any of the pumps could be made in a short time.

This design is by the James Reilly Repair and Supply Company, of New York.

It is reported that the British battleship *Dreadnought,* in a recent trial, made an average of 21.5 knots, the maximum being 22.25 knots. Horsepower, 28,000.



TRANSVERSE SECTIONS OF TURBINE PROPELLED FIRE BOAT, SHOWING LOCATION OF MACHINERY EQUIPMENT.

FLOATING DRY-DOCK CONSTRUCTION.*

By William T. Donnelly.

I have considered the subject under several general heads so as to give some comprehensive idea of it to those entirely unfamiliar with it, and then to go into the details of the construction of large floating docks, which will be of more interest to those already familiar or interested in the particular line of engineering. I shall first endeavor to give a general idea of what a floating dry dock is.

Fig. 1 shows a 10,000-ton floating dry dock with a large steamer upon it, the Fall River liner *Priscilla,* with which you are all probably familiar. A floating dry dock, as you will readily see, is a large floating structure, so large that it can not only float itself, but carry also the largest vessel for which it is designed. The steamer you see here is 440 feet long, 92 feet wide over the guards and has a draft of about 16 feet. The dock is 468 feet long, and is composed of five sections or separate floating parts, which are connected together and operated as one; these sections will be fully explained later.

The manner of getting this ship upon the dock was as follows: You will notice that on each side of the boat the dock has high, narrow sides which come above the water line of the boat, and you will readily understand that these sides, which carry the machinery, could be above the water, while the central part of the dock was far enough below the surface to allow the steamer to float in between them. Much the larger part of this dock is now below the surface of the water and is in the form of a large hollow box connecting the two high sides. All the different divisions of the dock are provided with means for letting in water and for taking it out.

The operation of this dock is as follows:

When the steamer was approaching to be docked, the dry dock was about at the level that you now see it, but, of course, the space between the high sides was vacant and all that you would see would be a long line of keel blocks down the center (some of which you can now see in front of the boat); those on which the steamer was to rest had all been carefully arranged to correspond with the keel of the boat, and certain blocks on each side, known as bilge blocks, had also been arranged. About the time when the steamer first came in sight the dockmaster gave instructions to open the flood gates. As soon as this was done, the water commenced to flow into the dock from the outside and the dock commenced to sink, the water flowed over the deck, then covered the keel and bilge blocks until nothing was left above the water but a long narrow strip on either side. When the dock had settled until there was about a foot more water above the keel blocks than the draft of this steamer, the flood gates were closed and the dock floated quietly. Then word was

*Paper before the Brooklyn Engineers' Club.

signaled to the steamer, which in the meantime had come up, and, if under steam, she steamed in or was pushed in by a tug, or perhaps was pulled in by her windlass engine hauling on the line, which you can see reaching from her hawse hole to the mooring post on the pier. When the steamer had been carefully located directly above the keel blocks which had been arranged to carry her, the machinery for removing the water was operated, and just as the letting in of water caused the dock to descend, the removal caused the dock to ascend, at first slowly, until the long line of keel blocks gently touched the bottom of the steamer. When firmly grounded on these the bilge blocks were drawn. This means that a certain number of blocks which had been arranged to support the vessel under each bilge or side were pulled inward from each side of the dock towards the center until they touched the steamer, and acted both as side supports and props to keep the vessel upright as she rose out of the water. When this was accomplished, the machinery was operated more rapidly, and the dock and vessel, which now became like one structure, rose together out of the water. The time from the location of the steamer in the dock until she was raised entirely out of the water, as shown, was about 45 minutes.

first floating dry dock, probably against the will rather than from the intent of the inventor. Old as this form of dock is and limited as is its use, there was within a few years one of precisely this construction in use in Weehawken Cove, Hoboken, for the dry docking and repairing of canal boats.

The germ of another line of thought has relation to the development of floating dry docks, and shows, as far as I am aware, the only recorded invention by a president of the United States, as this is a patent granted to Abraham Lincoln in 1849. From the "Life of Lincoln" we learn that about this time he made a trip on a flat boat down the Ohio and the Mississippi rivers, and it was undoubtedly his experience with sand bars and shoals on this trip that was the occasion of this invention, which is in the nature of additional buoyancy carried on each side of a boat to be used in water too shallow to float the vessel. The intention evidently was to lower the long hollow boxes which are on each side, into the water, and then to force them down into the water by means of ropes and framework. I am not aware that this invention ever came into use, and its inventor certainly had other and more weighty matters to think of in after years.

The first large floating dock which was built in this port is

FIG. 1.—10,000-TON BALANCED SECTIONAL FLOATING DRY-DOCK, TIETJEN & LANG DRY-DOCK CO., HOBOKEN, N. J.

I will next take up the historical side or the development of floating dry docks in the United States. The floating dry dock is generally considered to be an American invention, and this would seem to be probable from a patent issued to J. Adamson in 1816. This is one of the first patents issued by the United States, and was at a time when the patents were so few that the government had not discovered the necessity of giving each a number.

At this time a floating dock was a very simple structure. The idea originated from the wreck of an old hull laying on some sloping beach, which was used by cutting out the stern and making gates to close the opening, similar to those of a canal lock. When the gates were open and the water admitted, the structure rested upon the bottom, and at high tide the boat to be docked was floated in and located. As the tide receded the water left the dock, and when it was all out the gates were closed and its return was prevented. It can be seen at each side in the plan view that pumps were provided which were operated by hand. It is most probable that these were intended to take care of only the leakage. It is evident that this is not, strictly speaking, a floating dry dock, as it was evidently intended to rest on the bottom, but, as you will understand, at an extra high tide it must either fill over the sides or float, and at some time became the

the oldest floating dry dock now in use, and can be seen at the Erie Basin, Brooklyn. As originally constructed, this dock had a gate at each end, which was intended to operate after the principle of the dock invented by Adamson, but when completed it was found impossible to use it in that way. The reasons which led to its failure I will explain later when I come to describe the operation of the various forms of floating docks. This was, at the time of its construction, between 1845 and 1850, a very large structure, and it remains to-day the largest single structure in wood that has been undertaken for a floating dock. It is 330 feet long by 100 feet wide. It is known as the old balanced or box dock.

When it was found impossible to handle a single large floating structure with a ship upon it, the development took an opposite turn, and a number of small floating structures were built, to be connected and used together, and this form of dock has been known as a "sectional floating dock." It is composed of a number of separate floating sections connected together on each side by locking logs, which are designed to permit a limited amount of motion between the sections, while keeping them in alignment, particularly while sinking. The flexibility or movement between the sections made it necessary to provide some flexible means of transmitting power from one section to the others, and for this

purpose a double universal joint, with a slip or extension joint between, was invented. This will be more fully explained later. This dock, while having many undesirable features, was found to be very practical, and large numbers of them were built. The dock here shown has four sections. They have been built with from three to seven sections, which, with a section of about 25 feet in length, gave a dock about 200 feet in length, allowing for a short distance between the sections and a prow or overhang at each end.

The next type to which I will call your attention is shown in Fig. 2. This is known as a Dodge-Burgess sectional floating dock, and was the subject of a joint patent to them under date of October 9, 1841. The general arrangement of this dock is a number of pontoons, ten, as here shown, arranged and connected together as in a sectional dock by a locking log, but in this dock the wings are absent, as you will see in the cross-section, and in their place there is only a framework, upon the top of which the machinery house is carried. This framework is attached to the central pontoon and raises and lowers with it.

At each side, in the cross-sectional view, directly below the machinery houses, you will see a ballast tank. This tank always remains at the surface of the water, and is for the purpose of controlling the equilibrium of the lifting pontoon while submerged. The pumping of this dock is by machinery carried upon the top of the framework, and the power is distributed along the top by a shaft with flexible couplings, in the same manner as previously described for the sectional dock.

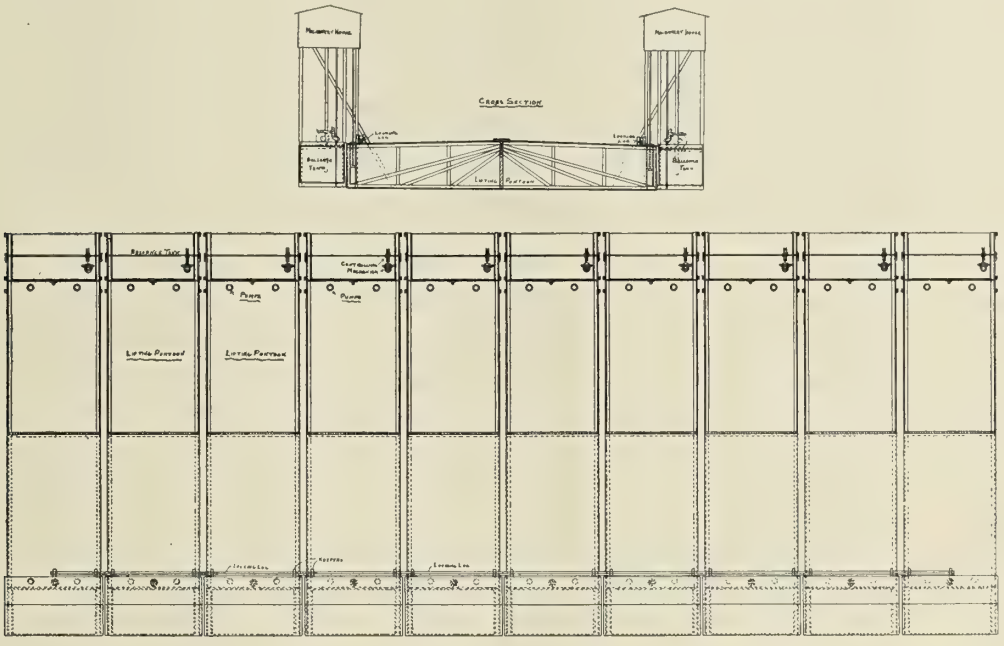


FIG. 2.—DODGE-BURGESS SECTIONAL DOCK.

This type of floating dock was the largest that had been built in this country up to a very recent date, and is probably the most familiar, as two of these docks were located upon the New York water front, near Catherine street ferry, for many years. The larger one was composed of eleven sections, each 30 feet long by 100 feet wide, it being understood that I speak of the length as 30 feet from the fact that this is the dimension which

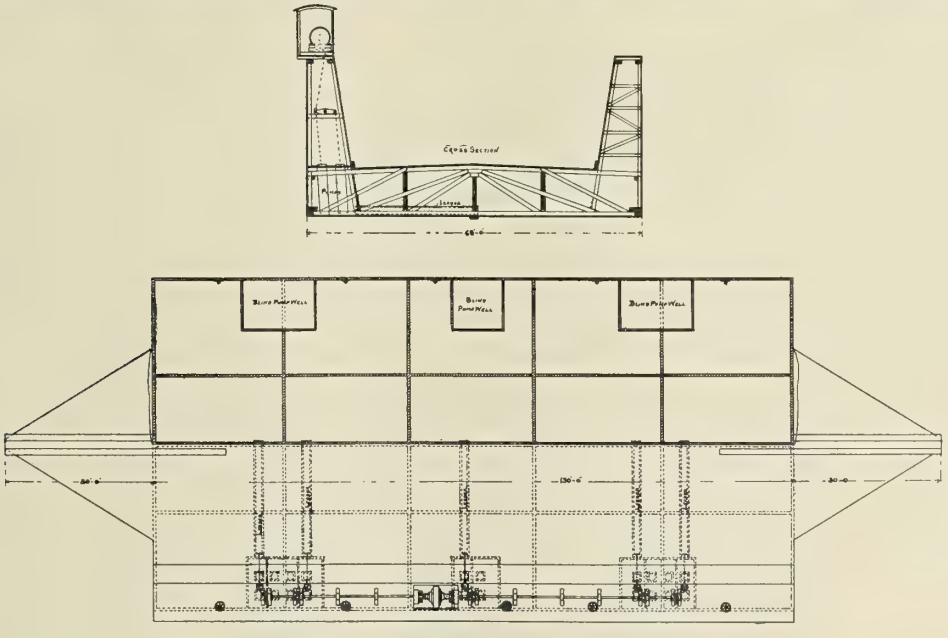


FIG. 3.—BOX DOCK.

forms a portion of the length of the dock when considered as a whole These sections, with the space allowed between them, made a dock about 350 feet long, having a lifting power of about 3,500 tons.

Fig. 3 shows the next development. This form is known as a box or balanced dock. As you will readily see, it was built in one piece, and, to overcome the difficulties occasioned by the flow of the water from one end of the interior to the other, the cross-bulkheads, which are water-tight, were added. These cross-bulkheads, four in number in this case, together with the center longitudinal bulkhead, divide the dock into ten independent water-tight compartments, and, by means of gates which control the flow of the water from all of these to the pumps, it is possible to control or balance the dock and ship.

The building of docks of this type commenced about the close of the civil war, and their construction continues at the present time; the small and moderate-sized are the most popular, and there are undoubtedly more of these docks, ranging in capacity from 500 to 3,000 tons, in the waters of the United States, than all other kinds taken together. This dock answers all the requirements up to a length approaching 300 feet. At about this length the proportion of length to depth is so great that it becomes impracticable to obtain sufficient longitudinal rigidity with wood as a structural material. A combination of wood and iron has been tried, but with very unsatisfactory results. The cost of a steel dock of this type is so much greater than one of wood, and its prospective cost of maintenance so much more, as to deter any attempt in that direction for commercial purposes up to the present time.

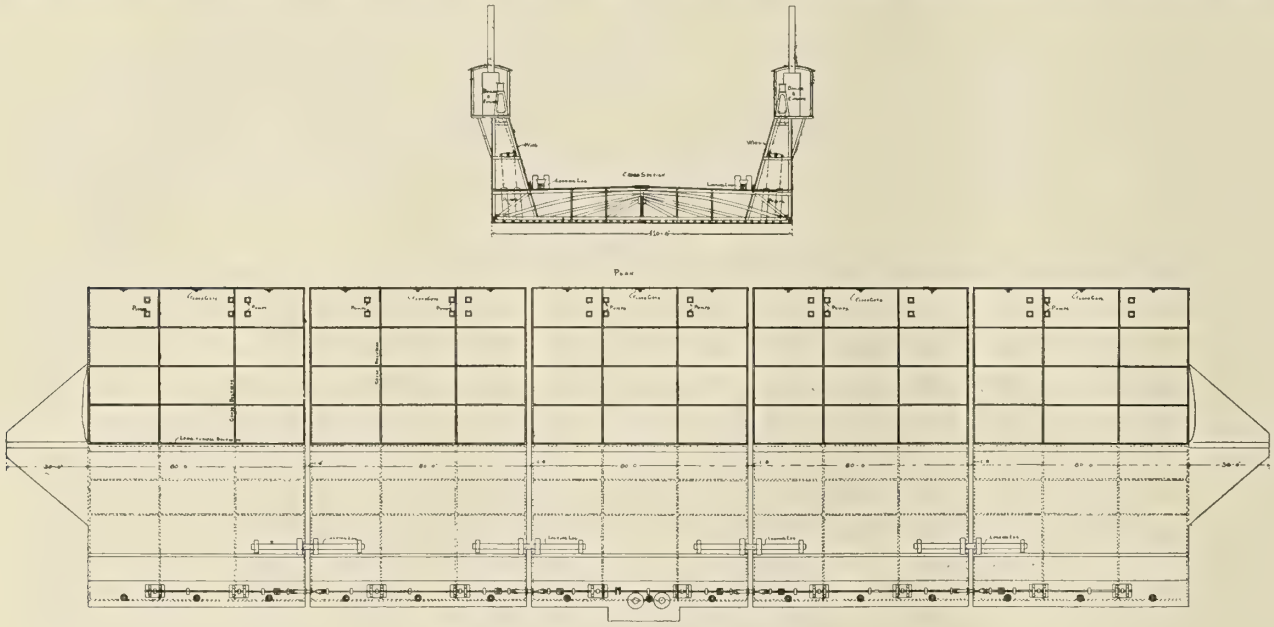


FIG. 4.—LANG'S BALANCED SECTIONAL DOCK.

I will now pass to the most recent development and largest type of floating dock for commercial purposes in use in this country. Fig. 4 shows a balanced sectional floating dry dock. Each of these sections, of which there are five, possess all the advantages of a box dock, that is to say, cross and longitudinal bulkheads and separate gates and independent means of admitting and removing water. Besides these, there are added all the advantages of the sectional dock, such as the freedom from internal longitudinal strains, and self-docking, which is a very important consideration in large docks.

The pumping machinery consists of a boiler and engine on each side of the dock. These operate a line shaft provided with flexible connections between the sections. This line shaft operates through intermediate gearing two pumps in each water-tight division of each section. As each section is divided into six compartments and there are five sections, there are sixty pumps. The dimensions of this dock are 468 feet long on keel blocks by 110 feet wide over all. The height of the wings is sufficient to take a draft of 21 feet over 3-foot keel blocks. The lifting capacity is 10,000 tons, or about three times the size of the largest commercial floating dock previously built in this country.

It is a most remarkable fact that from the building of the two Dodge-Burgess sectional docks, between 1850 and 1860, to the building of this dock in 1899, there was no large floating dock built in this country, and this is still more remarkable when it is considered that there was a constant growth in the shipping and a real demand for larger floating docks.

We will now pass to some illustrations of these docks in use. You can see that a floating dock lifts a vessel up out of the water almost to the level of the pier or wharf, and also how the scaffolding is rigged for cleaning and painting. You will understand that this scaffolding around a vessel in dry dock is the rule rather than the exception, as all work other than upon the under body or those parts below the water line is done while the boat is afloat, and, as the expense of keeping a vessel in dry dock is considerable, every possible facility is provided to execute the work in a short time, both by appliances and large numbers of men employed. The wooden horses on the pier are carefully designed to be strong and light, so that they may be readily carried off and on the dock, and at each side there are uprights hinged to the deck of the dock, which, when not in use, rest against the side, when in an upright position they are secured by iron braces. On one side they have a series of pins which support one end of the scaffolding poles, the other ends of which are carried by ropes, called "slings," from the side of the vessel. Below this scaffolding are the wooden horses, with planks upon them.

A good sample of a large box dock of recent design and construction is one built by James Tregarten & Sons, and now in use in their yard, foot of Seventh street, East river, New York. It is about 2,000 tons capacity, the length on keel blocks is 260 feet, length of box 186 feet 4 inches, and width over all 85 feet. The pumping machinery is operated by electricity, the motor being located and controlled in a small house on the right-hand wing. The current is led from a post on the pier by a flexible conductor.

Fig. 5 shows a smaller box dock of about 1,500 tons capacity. This dock is 130 feet long in the box and 190 feet long on the keel blocks, has a width over all of 68 feet, and will take a draft of 17 feet above 3-foot keel blocks. The body of this dock is

10 feet 6 inches deep, which gives it a very large lifting power for its dimensions. The design was developed particularly for the largest class of ocean-going tugs, having large concentrated weights. The machinery is operated by electricity and the handling of the motor is from the small house seen at the left on the pier. This enables the dockmaster to direct the location of the vessel upon the blocks and to start, stop and regulate the speed of the pumping himself, thus dispensing entirely with an engineer. Keel blocks, bilge blocks and scaffolding are shown.

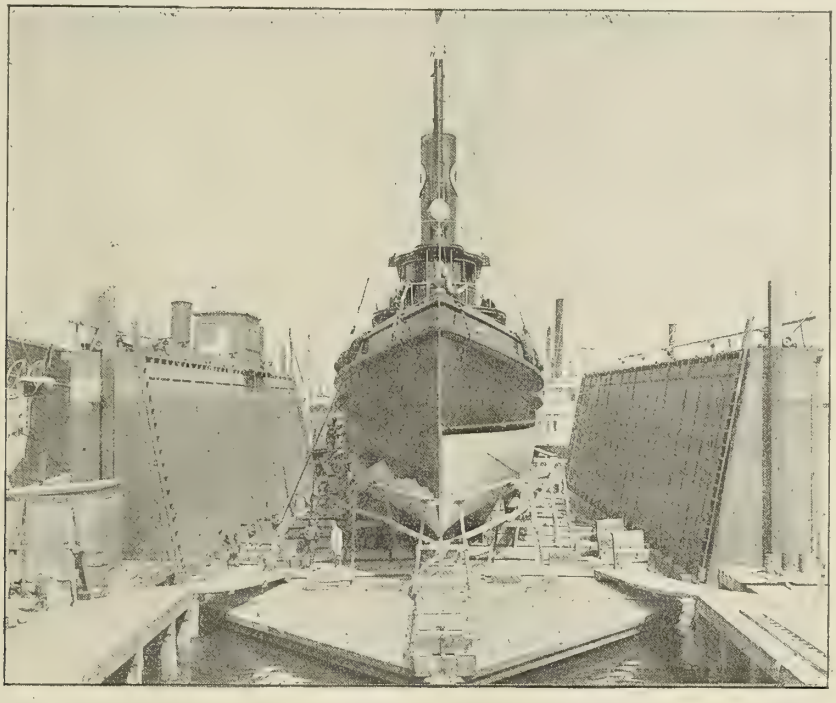


FIG. 5.—BOX DOCK, ELECTRIC DRIVEN MACHINERY.

The next view, Fig. 6, shows a basin dock. I show this for the purpose of comparison, so that those who are unfamiliar with the subject may readily understand how a floating dry dock differs from a basin dry dock. You will see here what appears to be a large opening or basin extending from the surface of the ground to a distance below the surface of the water corresponding to the greatest draft of vessel which it is intended to accommodate. The sides and bottom are made to exclude the water, and a gate which is removable is fitted across the entrance.

When the dock is full of water this gate is removed, and the vessel to be docked enters, and is located over keel and bilge blocks in the same manner as on the floating dock. Then the gate is replaced across the entrance and the pumping machinery is started, and, as the water is gradually removed, the vessel settles down upon the blocks. In this view the *Shamrock II*, well known as a contestant for the *America's* cup, is shown.

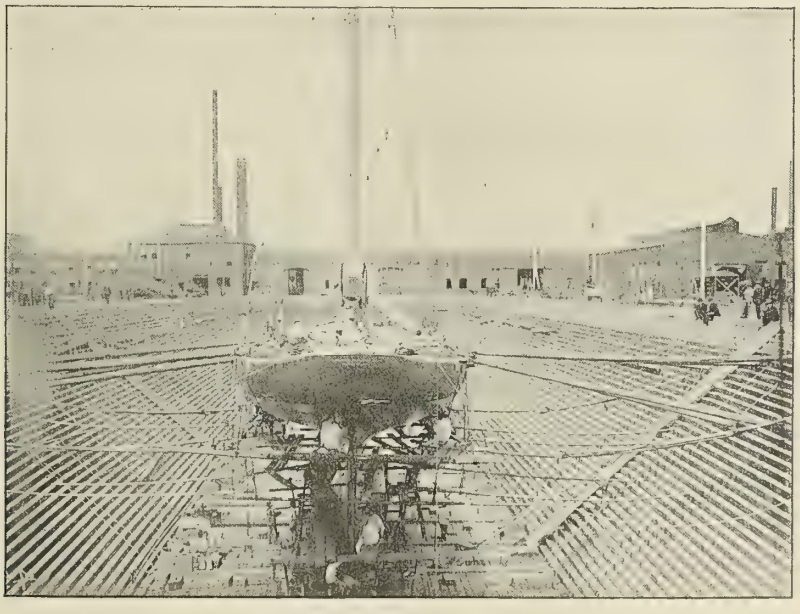


FIG. 6.—BASIN DRY-DOCK, ERIE BASIN, BROOKLYN. YACHT SHAMROCK, 2D.

While basin docks have been built to very much larger size than floating docks, on the other hand, floating docks have been built in much larger numbers, and are generally conceded to be much more handy and workable than basin docks.

(To be concluded.)

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Battleship-Cruisers

Since discussing in our September number the battleship design attributed to the Italian Admiralty, development in this respect has taken place in England which is far reaching in character, and inaugurates a new type of vessel of very great offensive qualities with respect to both gun power and speed. Particulars have just been given out covering the design of three so-called armored cruisers now being built on the Clyde and Tyne.

These ships are to have a displacement of 17,250 tons, with a length of 530 feet and a beam of 78½ feet. Each will carry eight 12-inch guns so arranged that all of these primary guns can be brought to bear at once upon either broadside. This gives them a broadside fire identical with that of the *Dreadnought,* and also the same as that in the two new American battleships.

The great departure in connection with vessels of such extreme offensive gun power is in speed. These ships are to be propelled by steam turbines of such a power as to enable them to attain a speed of 25 knots; it is even asserted that some disappointment will be felt if 27 knots is not attained. It is needless to say that the difference between 25 knots and 27 knots in such a vessel would represent a difference in effective or developed horsepower of from 25 to 30 percent, this representing an increase of at least 10,000 horsepower upon that required for 25 knots. A margin of 10,000 horsepower in the powering of any ship would ordinarily indicate poor design, but when it comes to an instrument of the flexibility of the steam turbine, an overload possibility of 25 or 30 percent, even when it represents 10,000 horsepower, is perhaps not unreasonable. In such a case the only question comes from the possibility that the boilers may not be able to furnish sufficient steam for such an enormous power.

It goes without saying that in order to attain such tremendous speed in conjunction with a very high gun power, sacrifices have to be made in some particular, and we understand that in this case it is the protective portion of the design which has suffered. The details at hand are so incomplete that little can be said in the way of comment upon the relation between speed, gun power and armor, as represented in these ships. With their possibility, however, due to extremely high speed, of choosing at will such fighting distance as best suits them, and with a battery of heavy guns of such power as to be available at a long range, compared with the bulk of the batteries of such ships as will oppose them, the matter of armor becomes one of almost secondary importance.

Fireproof Steamers.

We had occasion last May to comment upon the introduction of fireproof construction in steamers used upon our rivers, sounds and lakes. The leading article in our present number is a description of an excursion steamer for use on the Potomac river and Chesapeake bay, which has been made almost absolutely fireproof by the use of steel partitions everywhere, of asbestos fireproofing wherever necessary, and the abolition of wood construction in various fittings which are ordinarily made of wood and in the covering of much of the wood that is found to be necessary by materials either non-inflammable or very slow burning in character. Not content with this elaborate provision against the possibility of spread of fire, there has been provided the usual system of fire fighting equipment, in the way of pumps, hose and patent extinguishers. The result is a vessel about whose capacity for resisting or overcoming fire in its incipient stages there can be no reasonable doubt.

This sort of construction is doubtless somewhat more expensive than that usually adopted, but the difference in safety to the vessel itself ought to make full monetary return for any such additional first cost. This return is not only on account of the great saving in time and earning capacity which would be made by reason of a lesser liability to being put out of commission by a fire of either large of small dimensions; but also on account of the fact that it would probably be found feasible, even with a small fleet of vessels, to adopt a self-insurance plan, by which the regular premiums would be transferred to an insurance fund.

This would then take care of any fire losses sustained in the operation of the vessel. The enormous saving in total operating expenses brought about by this method of handling fire hazards is well known, being due, of course, to the fact that the insurance rates of the marine insurance companies are so high that there can be no question as to the ability of these companies to take care of all losses sustained by those insuring with them, without the slightest possibility of impairment of their capital. This capital in the present suggested case would be held by the company owning the steamers, and while, of course, the best financiering would not permit it to be considered an available asset of the company, yet in the last analysis it could not but be so considered, and the company would be correspondingly strengthened in that direction.

Aside entirely from the financial status of the case, we must consider the fact that the safety made possible by the use of fireproof construction would provide almost absolute security against loss of life. Not only this, but the very security offered by such construction would be in itself an immense inducement for people contemplating an excursion to patronize a steamer or line of steamers in which such conditions existed. There would thus be on this score still another financial inducement to adopt this method of construction.

There are many ways of looking at the problem, and in every one of them, except that of initial cost, the advantage lies enormously with the method of fireproof construction. In the one feature where the non-fireproof construction has the advantage, this advantage is more than offset by counterbalancing features in the safer method of construction. As developments in this line go on, it would be unreasonable to suppose that cost of production could not be cheapened, and brought perhaps to a figure not far different from the present cost of the less safe construction.

The Mauretania.

Nothing impresses upon one's mind an idea of immensity of any constructional feature of a new ship or building or machine so well as a comparison between that feature and something in common use and prominently in mind. For this reason the photographs reproduced in this number, in which the funnels and turbines of the new steamship *Mauretania* of the Cunard Line are shown with automobiles alongside, are of peculiar interest. Particularly so is the one at the top of page 440, where two motor cars are shown in the act of being driven side by side through a section of one of the funnels. It is seen in the photograph that they by no means fill the space, but that could this immense structure have been of such proportions as to utilize to the best advantage its volume for this purpose, three or four such cars could have been driven through it together. The Cunard Line has a reputation for placing extremely large funnels upon its ships. The *Campania* and *Lucania*, which are thirteen years old, have funnels measuring 26 feet in diameter on the long axis, and at the time of the launching of the former it is reported that a banquet was held in one section of one of the funnels, there being plenty of room for the large banqueting table, with covers laid for twenty-four guests.

Shipyard Management.

One of our articles in this issue gives a somewhat detailed account of the experience of a naval architect in his connection with various shipbuilding plants, private and governmental, all over the United States, but mainly on the Atlantic Coast. We are informed that the picture there drawn of poor management and favoritism is by no means overdrawn, and that this condition of affairs is very largely responsible for the fact that the construction of ships in American yards is so much more expensive than is the case in shipyards in Great Britain and Germany. Our correspondent had an experience along that line probably more extensive and more varied than could readily be found among his fellow workers. He seems to have stuck to his profession with a tenacity worthy of infinitely better results.

Other stories to the same effect, however, have come to our ears from sources the reliability of which cannot be questioned, and we are forced to the conclusion that mismanagement of this sort is an extremely common thing. Mistakes emanating from the use of poorly equipped and poorly paid workers are tremendously more costly than the reimbursement of well equipped and well paid workers and designers for their services. Not only this, but to accomplish the work required, a much larger number of the poorly paid men is found necessary than is the case with men whose professional attainments demand larger salaries and better working conditions. It is simply another case of the old saying, "Penny wise and pound foolish."

The proposed subsidizing of certain lines of steamers in the American merchant marine is expected, if carried into effect, to do an enormous amount of good in the upbuilding of this merchant marine, and in the re-establishment of our shipbuilding plants upon a paying basis, thus giving employment to larger numbers of men, and conducing generally to higher prosperity among those immediately affected. This sort of subsidy, however, can have no effect whatever upon the subject just reviewed, and, unless matters along these lines are remedied from within the profession, there will still be this great handicap to the fullest attainment of the possibilities inherent in our shipyard establishments. The subject is one which calls for careful introspection, with a view to remedying the faults now existing and rendering possible a fuller development of our resources along shipbuilding lines.

NOTES ON STAIRBUILDING.

BY H. S. TAFT.

As little if any information upon the subject of stairways and stair building can be found in the hand books usually referred to by the naval architect, a few notes upon this subject will no doubt be of value to those responsible for the proper solution of the many problems entering into ship construction.

Stairways should be laid out to meet the special conditions of the problem in question, the stairways in primary schools, or in buildings used mostly by children, being built with less "rise" and more "tread" than in the case of stairways used by persons of a more advanced age. Where there is plenty of room, or where ease and comfort in climbing are desired, a rise of 6 inches with a tread of 12 inches is considered the ideal condition. The ordinary stairway has a rise of 7 inches with a tread of 10 to 11 inches, though the back stairways of houses usually have a rise of 8 inches with a tread of 9 inches, the stairway being somewhat steeper than in other cases. The ladders used by fire departments have their rounds spaced about 12 inches center to center.

With all the varieties of solution, there still remain certain rules as regards the relation of rise to tread, almost universally employed by stair builders. Expressed in the form of equations they are:

$R \times T$ to be not less than 70, not more than 75;

$R + T$ to be not less than 17, not more than 18;

$2R + T$ to be not less than 23, not more than 25;

where R = rise, and T = tread. Considering that $R \times T = 72$, a diagram has been constructed, Plate No. 2 (the heights or total rise of the stairway being used as ordinates, and the spread or total tread being used as abscissae) by which the number of steps necessary in any given case to comply with the above equation, $R \times T = 72$, can be quickly determined.

To use this diagram, when the total height and spread of the stairway are given, it is necessary only to find the intersection of the horizontal and vertical lines corresponding respectively to the given height and spread of the desired stairway, and the nearest curved diagonal line will be the number of steps necessary. As an example, with a height of 8 feet and a spread of 12 feet, it will be found that 14 steps comes nearest to fulfilling the requirements. With the same height, and a little more spread, 12 feet 3 inches, it will make the rise and tread product just equal to 72, whereas, in the case of 8 and 12 feet, the product would be 70.5.

When the "slope" of the stairway is given, and it is desired to determine a satisfactory rise and tread, draw in the slope line from zero of diagram (upper left hand corner) and the intersection of this line with the diagonal curved line for 12 steps will give the proper relation of rise to tread to suit the equation of $R \times T = 72$. (In this case "height" and "spread" in feet on the diagram become respectively "rise" and "tread" in inches.)

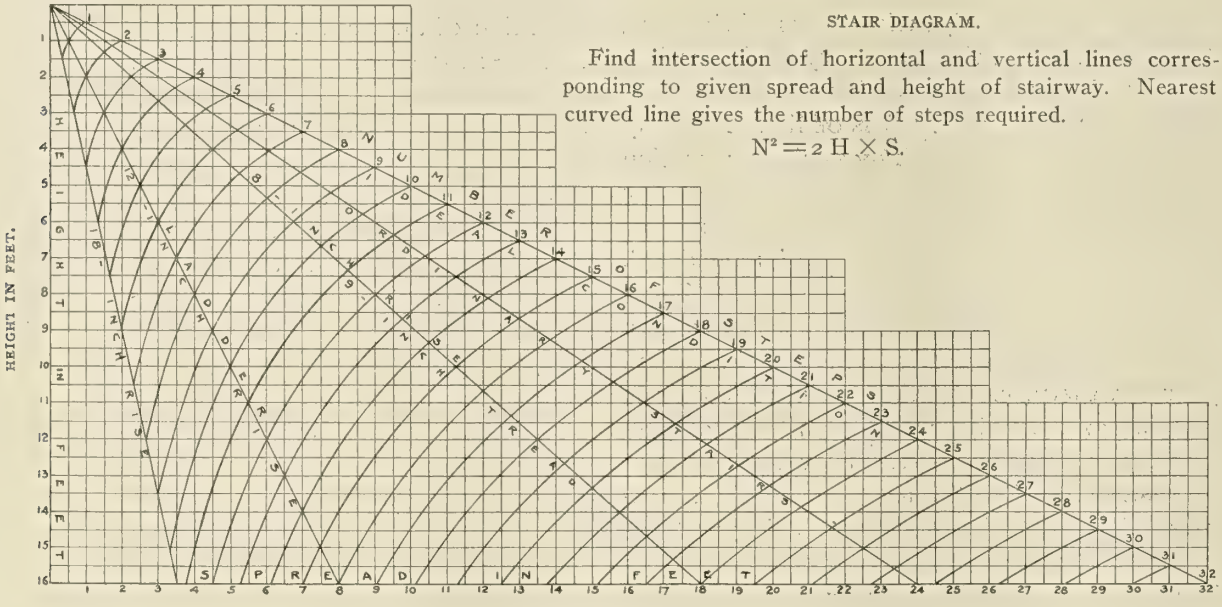
For a given rise or for a given tread (using height and spread in feet as rise and tread in inches), by finding the intersection of the corresponding horizontal or vertical line with the diagonal curved line for 12 steps, the corresponding vertical line or horizontal line will give the desired tread or rise to satisfy the above equation.

Where the space allowed for a stairway is restricted, and a steep set of stairs results—as in yacht design—it is the general practice to recess one step under another, 1¼ inches being the maximum allowance of recess. Some yacht builders use a universal rise of 8 inches with a tread of 6 inches.

STAIR DIAGRAM.

Find intersection of horizontal and vertical lines corresponding to given spread and height of stairway. Nearest curved line gives the number of steps required.

$N^2 = 2\,H \times S.$



The ordinary thickness of a wooden tread is 1⅛ inches, though it varies from ⅞-inch to 1⅝ inches. A wooden riser is usually ⅞ inches thick, being dovetailed into both steps, with a small beading across the top.

Where hand rails are used with stairways, they should be placed between 2 feet 5 inches and 2 feet 8 inches above the steps, measured vertically on a line with the face of the riser (outer edge of step), 2 feet 6 inches to top of rail being considered the best practice. Railings around wells or on landings should be from 2 feet 8 inches to 3 feet high.

NOTES TO ACCOMPANY TABLE.

1. ⅝-inch round iron "spills" should not be used for spans over 18 inches.

2. ¾-inch round iron "spills" should not be used for spans over 27 inches.

3. For wider spans, additional supporting bars, of the same section as the side bars, should be used.

4. Ladder step should be from 9 to 10 inches apart (face to face).

5. Cast iron step should have rounded corners and be attached to the side bars by two ½-inch bolts at each end.

6. The main engine room ladder should be 21 inches wide if possible, but 24 inches in large ships, where plenty of room is to be had. Stoke-hold ladders need not exceed 18 inches in width. Said ladders are usually built with round bar-iron steps.

LADDERS AND GRATINGS.

Ladders							"Spill" Gratings			
Width of Ladder	Size of Side Bars for Cast Iron Steps	Size of Side Bars for Round bar Iron Steps	Width of Cast Iron Steps	Bar Iron Steps Number	Bar Iron Steps Size	Bar Iron Steps Pitch	Width of Grating	Size of Side Bars	Diameter of "Spills"	Pitch of "Spills"
12 Inches	—	2¼ × ⅜	—	1	⅝	—	15 and 18	2¾ × ⅜	⅝	2¼
15 "	—	3¼ × ⅜	—	2	⅝	1⅜	21	3 × 7/16	¾	2⅜
18 "	3½ × ⅜	3½ × ⅜	4¼	2	⅝	1½	24	3 × 7/16	¾	2⅜
21 "	3¾ × 7/16	—	4¾	—	—	—	27	3 × 7/16	¾	2⅜
24 "	4 × 7/16	—	5¼	—	—	—	30 & above	3 × 7/16	*a* ⅝	2¼

a With a Center Support. All Sizes are in Inches. FROM SEATON.

7. The inclination of the main engine room ladder should be 1 in 2¼ when possible.

8. Hand rails should be 1 inch in diameter.

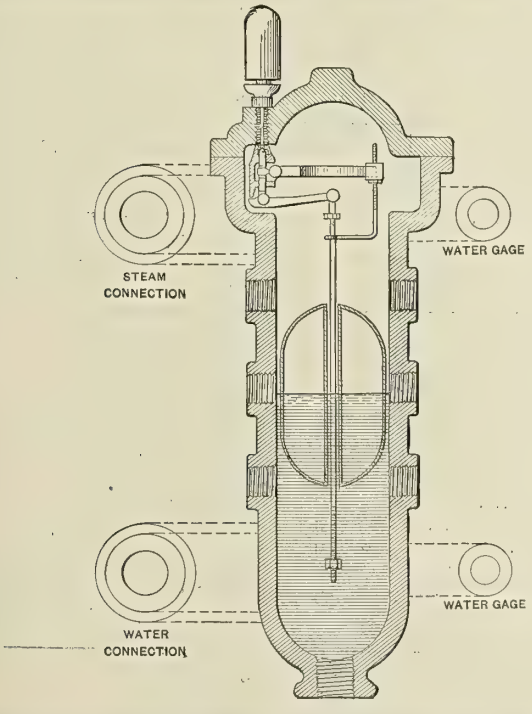
9. Stanchions, when 3 feet in height, should taper from 1 inch diameter at the top to 1¼ inches at the bottom; when short, for ladders, ⅞ inches at the top to 1 inch at the bottom is enough. The ball for the rail to pass through should be 2 inches in diameter.

10. The engine room chequered floor plates should be 5/16 inches thick; and the boiler room plates ⅜ inches, exclusive of the raised pattern. In the navy ¼-inch and 5/16-inch respectively are used.

ENGINEERING SPECIALTIES.

High and Low Water Alarm Columns.

The Turner combined water alarm column is designed to give automatic notice when the water in a boiler gets above or below a pre-determined desired height. The cut shows the general



construction, which includes a seamless copper float, operating the whistle at such points as may be determined by the setting of the valve. The columns are made in five sizes, of extra heavy design, and suitable for any pressure. Steam and water pipes are connected direct to the body of the column, permitting the removal of the cap without disconnecting either pipe. They are placed upon the market by the Binghamton (N. Y.) Machine Tool Works.

Wrought Steel Floor Plates.

Produced in a variety of patterns, including diamond, ribbed, and checkered patterns, the floor plates placed upon the market by the Sligo Iron & Steel Company, of Pittsburg, are designed

for use in boiler and engine rooms, for deck plates and gutter plates, platforms, sills and stair treads, or any place on board ship where a rough serviceable surface is desired. They are rolled from steel boiler plates, and weigh approximately three pounds per square foot for each sixteenth of an inch of body thickness. The plates are made in a variety of widths running up to 50 inches, and in lengths as great as 12 feet.

TECHNICAL PUBLICATIONS.

Brazing and Soldering. By James F. Hobart. Size, 5½ by 8 inches. Pages, 33; illustrations, 16. New York, 1906. The Derry-Collard Company. Price, in paper covers, 25 cents.

This little book is No. 5 of a series of practical papers being issued by the publishers, and gives practical advice regarding the two closely related subjects of brazing and soldering. The arrangement of gas and air pipes for use in brazing furnaces, the use of small blow pipes and of soldering irons and the various other devices used for these purposes, are illustrated and described, together with the necessary solutions for cleaning the surfaces to be operated upon, and for use as fluxes.

Directory of the Alumni of Stevens Institute of Technology. Size, 4½ by 7¼ inches. Pages, 132. Hoboken, N. J., 1906. Published by Stevens Institute Alumni Association. Price, $0.50.

This is a directory in three parts, of which the first two are respectively alphabetical and geographical lists of the alumni, while the third is a business directory in such detail that many of the men are listed under several separate headings.

Wiring a House. By Herbert Pratt. Size, 5½ by 8 inches. Pages, 21; figures, 6. New York, 1906. The Derry-Collard Company. Price, in paper covers, 25c.

This little book gives practical advice as to methods to be used in both designing and installing an electric circuit in a house. The principal use of the current would be for lighting, but, of course, it could be used to some extent for other purposes.

Management of Electrical Machinery. By Francis B. Crocker, E. M., Ph.D., and Schuyler S. Wheeler, D. Sc. Size, 4¾ by 6¼ inches. Pages, 223; illustrations, 131. New York, 1906. D. Van Nostrand Company. Price, $1.00 net.

The present work, which is the sixth edition, is a thoroughly revised and enlarged edition of "The Practical Management of Dynamos and Motors." It covers the subjects of the Selection and Management of the various machines found in power houses; Inspecting and Testing these machines; the Localization of Troubles and the Remedies Therefor; and Constant Current Generators for use in connection with arc lighting.

The basic principles of generators and motors are taken up very briefly, much information being given upon practical details in the way of direct and belt drive, chain drive, etc., after which the various details of wiring and fuse connections are discussed. Diagrams are given showing the operation of machines under varying conditions, while the instruments of measurement are described at some length. The subject of Power and Efficiency is given a separate chapter, while the subject of Troubles is treated in considerable detail. A complete index at the rear adds its quota to the value of the work.

Manual of Wireless Telegraphy. By A. F. Collins. Size, 4¾ by 7¼ inches. Pages, 232; figures, 90. New York, 1906. John Wiley & Sons. Price, bound in cloth, $1.50 net; morocco, $2.00 net.

The purpose in the preparation of this manual was to give detailed and explicit instruction for wiring various types of sending and receiving apparatus now in general use, the adjustment of the instruments, tuning and syntonizing the circuits, testing the devices, and the management of ship and shore stations. It was realized that the most proficient operators are those who combine in highest degree theory with practice. If the principles involved in the system under operation are clearly understood, the adjustment and manipulation of a tool is much easier than where the results are groped after blindly. It was to furnish this information that the book has been issued, many of the difficulties usually encountered being explained in such a manner that the operator may easily overcome or circumvent them. The subject is gone into with considerable detail, and is well illustrated with both line drawings and half tones.

The different makes of equipment are explained, a list is given of stations and liners equipped with the Marconi apparatus, and another list of De Forest stations and ships, while the United States Navy ship and shore stations are outlined.

In the rear of the book are to be found a chart of the Atlantic ocean communication lines of various steamships and operating stations under the Marconi system; also a bibliography of books covering the subject, in English, French, German and Italian. A glossary of wireless telegraph words, terms and phrases, and an unusually complete index end the volume.

Technical Dictionary. Volume 1: Machine Details and Tools. Compiled by K. Deinhardt and A. Schlomann. Size, 4 by 7 inches. Pages, 403; illustrations, 823. New York, 1906. McGraw Publishing Company. Price, $2.00 net.

This is the first of a series of similar technical dictionaries published in six languages; English, French, German, Russian, Italian and Spanish, and is intended as an assistance to the engineer in the reading and study of technical articles and books. The work contains three distinct parts; an index, a systematic arrangement of the text, and an alphabetical index of the words. Each item mentioned or described is given in all the six languages and a large portion of the items are illustrated by small line cuts in such manner as to readily identify the terms as used. The index of words is arranged in two sections, the first including the five languages using the Latin characters, while the other section is devoted to the Russian language. The general scope of the work is such as to commend itself to those whose duties call upon them for frequent use of other languages in connection with technical subjects, and as the entire scheme embraces a total of eleven volumes, classified as to the general subjects included, the possession of one or two or more of these volumes by each engineer interested should enable him to take care of any work of this character along his own special line.

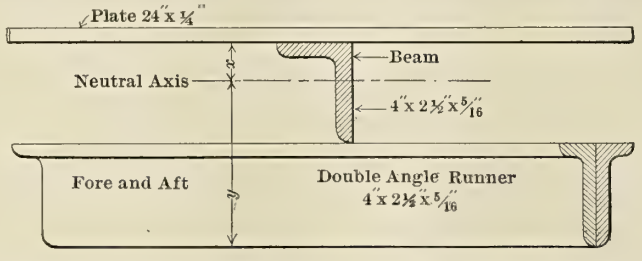
The remaining volumes which are yet to appear are as follows:

Electric plants and machines; Steam Boilers and Engines; Hydraulic Machinery; Hoisting and Conveying Machinery; Small Tools and Machine Tools; Railways and Locomotives; Structural Iron Work and Bridges; Metallurgy; Architecture; and Naval Construction.

QUERIES AND ANSWERS.

All reasonable questions concerning marine engineering received from and signed by subscribers will be answered by the Editor in this column. All communications must bear the name and address of the writer.

Q. 345.—I inclose calculation of neutral axis and moment of inertia of beam and deck; also of beam under deck with double angle runners attached. The first works out (according to my calculation) as =0.87; the second as 3.71. What have I proved? Can I express it in tons? Assume



an ordinary ship's frame with reverse bar. How can I calculate an equivalent Z bar? Would not sectional area do, or must I work out a moment of inertia?

I presume this moment of inertia would apply to timber as well as steel.

Far Off Subscriber.

PLATE AND BEAM.

Items	Dimensions	Area	Leverage	Moment	Moment of Inertia
Plating	24 × .25	6.000	− .125	− .750	.125
Horizontal Flange	2.188 × .312	.683	.156	.106	.221
Vertical Flange	4 × .312	1.248	2.000	2.496	6.656
		7.931		1.852	7.002

$\frac{1.852}{7.931} = 0.233$, locating neutral axis below under side of plate. $Y = 3.767$ inches.

PLATE AND BEAM WITH RUNNER.

Items	Dimensions	Area	Leverage	Moment	Moment of Inertia
Plating	24 × .25	6.000	− .125	− .750	.125
Horizontal Flange	2.188 × .312	.683	.156	.106	.221
Vertical Flange	4.000 × .312	1.248	2.000	2.496	6.656
Runner, Horizontal Flange	2.188 × .312	.683	4.156	2.839	11.790
Runner, Vertical Flange	4.000 × .312	1.248	6.000	7.488	46.590
		9.822		12.177	65.382

$\frac{12.177}{9.822} = 1.24$, locating neutral axis. $Y = 6.76$ inches.

A.—The moment of inertia in the first case is not 0.87 but is 6.571, this being the figure obtained by our subscriber, and then put through another operation which we do not understand. In the second case, the moment of inertia would be similarly 50.275, were it not for the fact that the fore-and-aft runner under the

beams has nothing whatever to do with the transverse stiffness of the vessel, and, therefore, cannot enter into the computation for a moment of inertia in this direction. As a result, the moment of inertia is 6.571, as before.

The calculation appears to be based on a beam spacing of 24 inches, and has been made without reference to the cutting of beam and plate for rivets. Such parts of the section as are under tension at any given moment will properly have moments of inertia less than that calculated, by an amount varying from 12 to 17 percent, depending upon the character of the riveting. Portions under compression would have no deduction for rivet holes, providing the rivets were well driven. The total deduction to be made in a case like this would probably be not far from 6 to 8 percent of the total, thus leaving the moment of inertia of the plate and beam at about 6.2, in each case.

The moment of inertia of any such beam is merely a mathematical quantity which is used in connection with the resistance of the beam to bending. It is expressed in inches raised to the fourth power; that is, in square inches times square inches, and not in tons.

In a comparison between an ordinary ship frame and reverse bar on the one hand and a Z-bar on the other, the sectional areas of the two, if the depth is the same, would be approximately proportional to the moments of inertia. In order, however, to obtain an exactly equivalent Z-bar to any given combination of frame and reverse frame, a regular calculation for moment of inertia would have to be made for each case, the proper Z-bar being determined by a process of trial and error. One or two approximations in the hands of an experienced operator would give results as close as might be desired.

The subject of moment of inertia has to do with the form and position of the various members of a structure undergoing examination, and has really nothing to do with the quality of the material making up that structure The latter item enters the calculation when the subject of strength is being examined. The formula for the stress in a member of this sort is $p = \frac{Me}{I}$ where p is the maximum load on the member, in pounds per square inch of section; M is the bending moment expressed in inch pounds; e is the distance from the neutral axis to the outermost portion of the member, and I is the moment of inertia, expressed as above in biquadratic inches. It is in comparing p with the unit strength of the material to be used that the quality of this material enters the problem.

Q. 356.—What power will it take to drive a flat bottom stern wheel boat 24 feet long, 8 feet beam with uniform draft fore and aft at 6 miles per hour in dead water? The displacement is 2½ tons.

How many revolutions per minute would be required to make that speed with a wheel 6 feet in diameter carrying ten 9-inch blades, 7 feet long?

What would be the percentage of slip? R. M.

A.—Referring to page 279 in our issue for July, a formula is found which will give approximately the required power in the case of any small boat, where sufficient data is at hand to make the computation. Judgment is necessary in applying this formula, which is:

$$H = \frac{AB}{K}.$$

In this case H is the horsepower; A is a factor depending upon the displacement; B is a factor depending upon the speed, and K is a factor to be selected by judgment, and depending upon the form of the hull as compared with the results to be attained.

In the present case $A = 3.15$; $B = 216$; K is taken at 250 for a vessel of this character, and the result gives 2.72 horsepower required. It therefore follows that if an engine of 3 horsepower be fitted, it could be reasonably expected that a speed of 6 miles per hour would be attained.

Under ordinary conditions a slip of about 20 percent might be expected. It thus follows that a speed of 6 miles per hour would mean $\frac{6 \times 88}{1 - .20}$ or 660 feet per minute for the blades of the wheel. As the mean diameter is 6 feet, the circumference would be 18.85 feet, and the number of revolutions per minute would be 660 ÷ 18.85 or about 36.

Q. 357.—Is block coefficient simply the immersed portion of the vessel subtracted from an oblong, or block, having the same length, breadth and draft as ship? Does coefficient of fineness mean the load water area or L. W. L. plane subtracted from an oblong with the same length and beam as vessel? What is considered a ton in shipbuilding, 2,000 pounds or 2,240 pounds? J. D.

A.—The block coefficient is the ratio between the volume of the immersed portion of the vessel and the volume of an oblong block having the same length, breadth and draft as the ship. The coefficient, as stated above, is a ratio or proportion.

The coefficient of fineness is a term which is used for a great many such ratios, as explained at page 245 in our issue for June, 1906. In the special case of the load water plane; the coefficient of fineness of that plane is the ratio between the area of the plane and the area of an oblong of the same length and breadth.

In shipbuilding, a ton is universally the gross ton of 2,240 pounds, instead of the net ton of 2,000 pounds.

Q. 361. (1).—If steam in a boiler rises from low to high pressure simply by the addition of heat, why does not the addition of superheat to the steam in pipes connected directly to the boiler raise the pressure? In other words, why does not superheat raise pressure?

(2) What is saturated steam saturated with: water, watery vapor or heat? What is steam-saturation? D. H.

A.—(1) If steam were a perfect gas, the addition to it of heat would invariably increase the pressure in an amount proportional to the addition of heat. As a matter of fact, however, steam behaves differently from a perfect gas, and it is found possible to add heat without corresponding increase in pressure. This added heat raises the temperature of the steam and produces what is known as superheated steam, the increase in pressure due to this addition of heat being almost negligible. Steam cannot exist at a lower temperature than that corresponding with its pressure; but, as mentioned above, it can exist at a temperature *higher* than that corresponding with its pressure. As soon as the temperature is lowered below that corresponding with the pressure, a certain amount of condensation takes place, thus automatically keeping the pressure down at least sufficiently low to correspond with the temperature.

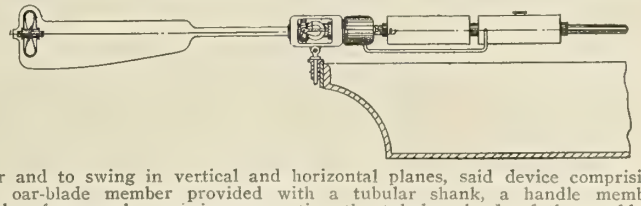
(2) The term "saturated steam" covers a condition of steam in which the amount of water vapor contained is exactly equal to the amount which the steam can absorb without showing perceptible moisture. Any quantity of vapor greater than this would be precipitated in the form of moisture or condensation, while a lesser quantity would result in the steam's being superheated. The term "saturated steam," or, as it is frequently written, "dry and saturated steam," involves an apparent contradiction from the usual acceptation of the word "saturate." As explained above, however, the expression is used for simply one point in the curve showing the quantity of vapor contained in the steam, namely: that at which the steam is neither moist nor superheated, but is on the dividing line between the two.

SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

827,202. MEANS FOR PROPELLING AND STEERING OR GUIDING BOATS. HENRY BACHMAN, NEW YORK.

Claim.—1. A combination steering and propelling device for boats adapted to be mounted on the stern of the boat in the manner of an

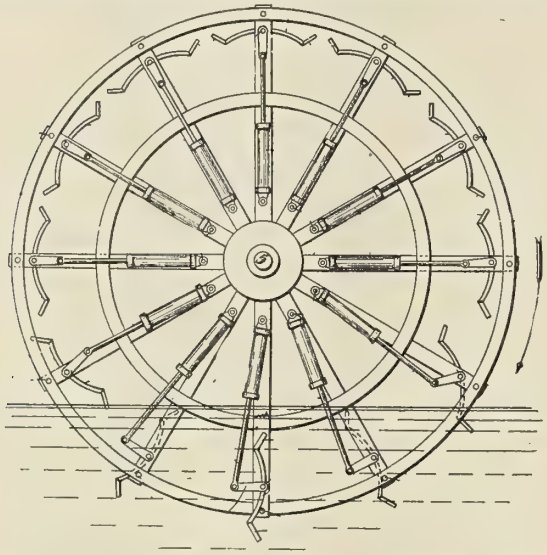


oar and to swing in vertical and horizontal planes, said device comprising an oar-blade member provided with a tubular shank, a handle member and a framework or casing connecting the tubular shank of the oar-blade member and said handle member, a shaft mounted in the oar-blade member and provided at its outer end with a propeller and at its inner end with

a beveled gear-wheel, two cylinders mounted in the opposite sides of the framework or casing and provided with pistons and piston-rods geared in connection with said bevel gear-wheel, and means for operating said pistons. Two claims.

827,216. FEATHERING PADDLE-WHEEL. WILLIAM N. CRUCHON, SEATTLE, WASHINGTON.

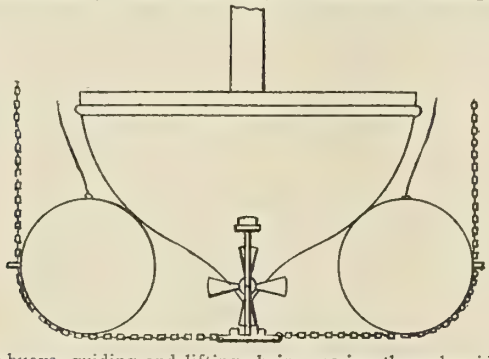
Claim.—5. In a paddle-wheel the combination of a bucket pivotally connected thereto, means carried by the buckets for tilting the same as



said means come in contact with the water, and spring actuated means for returning said bucket to its normal position after it has emerged from the water. Five claims.

827,477. MEANS FOR RAISING SUNKEN VESSELS. JOAO GONCALVES FERREIRA TITO, RIO DE JANEIRO, BRAZIL.

Claim.—1. The combination with caisson-buoys each provided with means for exhausting water therefrom, of automatic clutch-guides upon



said caisson-buoys, guiding and lifting chains passing through said automatic clutch-guides, supporting-plates attached to the lower ends of said guiding and lifting chains, and coupling chains connecting adjoining supporting-plates. Two claims.

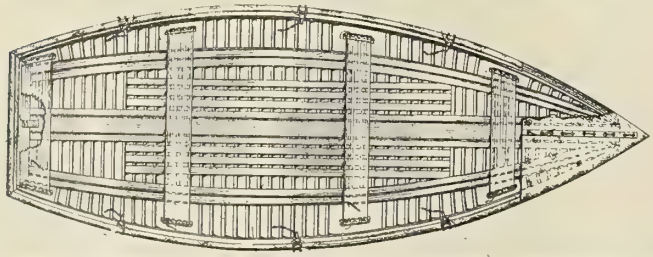
827,619. PROPELLING MECHANISM FOR VESSELS. WALLACE W. COX, PUNGO, VA.,

Abstract.—This invention has for its object to provide a simple and effective motor-driven propelling mechanism of the side-wheel type for launches and other small vessels, the same embodying friction-gearing readily controllable to stop the vessel and propel it forward and backward at will. One claim.

827,916. SUBMARINE TELEGRAPHY. ISIDOR KITSEE, PHILADELPHIA, PA.

Claim.—1. Means to translate the received impulses of submarine or other cables, said means embracing a receiving device provided with a free swinging coil, mechanical means adapted to move in unison with said swinging coil, a local circuit, a source of current for said circuit, a transmitting device for said circuit and means whereby through the contacting of part of the mechanical means with part of the receiving device a shunt around part of the translating device is made or broken. Two claims.

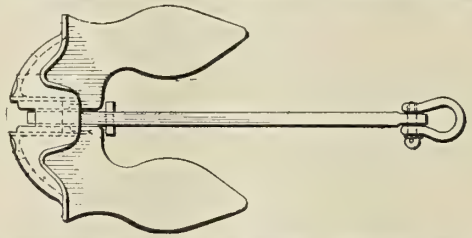
828,072. BOAT. BERNT TENNESON, PHILADELPHIA, PA.; OLEVINE TENNESON AND WILLIAM H. BAKER, EXECUTORS OF SAID BERNT TENNESON, DECEASED.



Abstract.—The objects of the invention are to furnish an improved means for securing the upper sides of the canvas cover to the wooden inner part of the boat, to furnish an improved means for detachably securing the thwarts to the boat, and to furnish an improved means for securing in place a detachable square stern. Three claims.

828,757. ANCHOR. FRANK S. MANTON, PROVIDENCE, R. I., ASSIGNOR TO THE AMERICAN SHIP WINDLASS COMPANY, PROVIDENCE, A CORPORATION OF RHODE ISLAND.

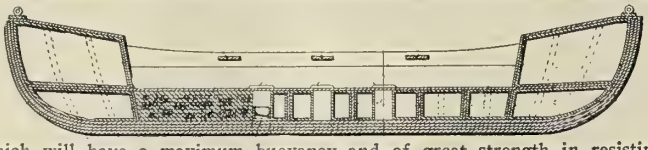
***Claim.*—2.** In an anchor, the combination with a scalloped head-piece having two oppositely-extending shoulders carrying flukes and two



hook-shaped shoulders extending in opposite directions at right angles to the plane of said flukes, said head-piece having a series of perforated pockets one arranged opposite each scallop and between adjacent shoulders, of a shank having pivotal connection with said head-piece. Four claims.

828,852. LIFE-BOAT. OLIVER R. INGERSOLL, BROOKLYN, N. Y.

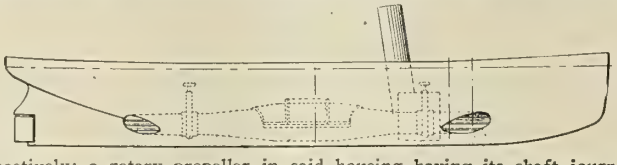
Abstract.—The invention relates to improvements in boats of that class or style denominated "life-boats;" and the objects are to provide such a boat built of metal which will be positively self-righting and self-bailing,



which will have a maximum buoyancy and of great strength in resisting the exigencies of the service, and which is capable of withstanding the effects of accidental or intentional puncture by bullets or other missiles. Two claims.

829,033. MEANS FOR VESSEL PROPULSION. THOMAS RONSTROM, CHICAGO, ILLINOIS.

Claim.—1. A vessel having a substantially cylindrical propeller housing or waterway at the lower part of the hull having its axis in the vertical mid-plane of the hull; two water-passages leading from each end of said housing or waterway symmetrically disposed with respect to said vertical mid-plane, and emerging through the hull toward the bow and stern



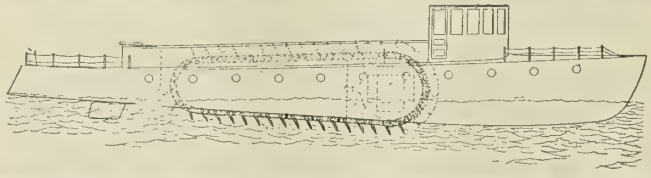
respectively; a rotary propeller in said housing having its shaft journaled at the end thereof between the two water-passages at each end, said housing having a cap at the upper side, removable for access to the propeller, and water-gates in each of the four water-passages Two claims.

829,054. LIFEBOAT LOWERING AND HOISTING APPARATUS FOR USE ON SHIPS. JOHN BOAG, KEARNEY, N. J.

Claim.—4. In an apparatus of the class described a horizontally-arranged davit-shaft, davits connected with said shaft and adapted to turn therewith, means for limiting the movement of said shaft, a transversely-arranged shaft geared in connection with said davit-shaft, means for operating the transversely-arranged shaft, a drum divided into two parts, ropes connected with the separate parts of said drum and arranged to suspend a boat from said davits, said ropes being adapted to be wound on or unwound from said drum according to the direction in which the drum is turned, and means for operating said drum, said drum being also provided with a brake and with a lock. Eight claims.

829,378. PROPELLING MECHANISM FOR VESSELS. PETER A. COUPAL, BOSTON, MASS.

Claim.—1. A propelling mechanism for vessels, comprising a plurality of circuit-tracks suspended from the body of the vessel, and in part extended below the bottom thereof; a train of paddle-trucks disconnected



with each other, but together supported by and traveling upon said tracks; a sprocket-wheel constructed and arranged to engage in succession the paddle-trucks and to propel the same along said tracks; and means for turning said sprocket-wheel. Two claims.

James Donald, naval architect of the New York Shipbuilding Company, Camden, N. J., was married September 29 to Miss Elizabeth Moore. Mr. Donald, who is a native of Glasgow, came to the United States about ten years ago, since when he has been prominently identified with the largest shipbuilding companies in this country.